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BRIEFLY TOLD.

ENGLAND AND HER GAS COALS.—In our issue for August 20th last we had occasion to make trifling comment on the coal supply of England, our remarks naturally having more connection with that supply in so far as coal for gas making was concerned. It seems that our comment was warranted, for since then several exports of gas coal to the mother country have been made, notably one shipment of perhaps 4,000 gross tons to the South Metropolitan Gas Company, of London, whose managing man, Mr. Livesey, has posed as the gas controller of the English Metropolis for well over three decades. His fame as the controller of that vast supply is hard piled, since he knew and appreciated in the earlier days of his association therewith how many bogs had to be paved. However, coming back to our story, with a view to illustrating how the tide of gas coal flows, we reproduce the following editorial entitled "American Coal in London and Europe," that appeared in the *Journal of Gas Lighting*, dated August 28th:

"One swallow, we know, does not make a summer, nor does one cargo of Philadelphian coal in the River Thames make a wholesale and permanent invasion of the English coal market by American mineral. But, as in the one case so in the other, its advent is of significance. So, in fact, it has been recognized to be by the Daily Press; for at the latter end of last week it was impossible to open any newspaper without receiving the information that the steamer 'Queenswood,' with a cargo of something less than 4,000 tons of Philadelphian gas coal, had arrived in the Victoria Dock, and that her cargo was being unloaded for lighterage to the works of the South Metropolitan Gas Company. Indeed, some of those papers with ill-balanced judgments that have been talking so much of such little value about the coal difficulty of late have attached an altogether exaggerated amount of importance to this incident; for, as has been pointed out in these columns more than once, it is impossible for American coal to be profitably put on the English market in any but the most abnormal of times, such as the present. That is evident from a consideration of the freight difficulty. The "Queenswood's" cargo, it is stated, was carried at a rate of 16s. per ton, which is under rather than over the usual freight charge from the States to this country. The freight from the Tyne to the Thames is, on an average, about 3s. 6d.; and it is obvious that it will never be possible for the two figures quoted to come within measurable distance of being equal, especially bearing in mind the difficulty which any additional coal vessels that might be sent eastward across the Atlantic would experience in finding cargo for the return journey westward.

"It is further obvious that a difference of, say, 12s. per ton in freight could not be counterbalanced by a correspondingly lower f.o.b. price in any ordinary years, when Durham gas coal is shipped at about 6s. to 7s. a ton. Indeed, if report be correct, the shipping (f.o.b.) price of the recently unloaded cargo was 12s. per ton, which is only about 5s. less than the highest prices marked at the present time for Durham coal. This leaves, even under the existing abnormal conditions, a balance of 7s. to 8s. a ton against the American coal. As, however, Mr. Livesey has purchased the cargo in question on the strength of an estimated make per ton of 15,000 cubic feet of gas, the experiment—for

such it is—was well worth the making just now. We have no doubt that, in accordance with his accustomed generosity to the industry, Mr. Livesey will in due time let us know the result. What, of course, has to be determined is not only the quantity of gas produced and its illuminating power, but also the value of the residual products.

"Whatever the outcome of the experiment, the advent of American coal in London serves as a useful reminder to the English coal owners that there is a limit to their monopoly. At reasonable prices, of course, their coal must always command the home market, and, within stricter limits, the Continental markets also. But, with the possibility of American intervention present in their minds when coal in this country rises considerably above the normal level, the colliery proprietors here must recognize that, now that the American coal fields are being rapidly developed (and their output is the heaviest of any nation), a bound has been marked beyond which it will not be possible for them to go far for any considerable length of time. It is, however, rather from the competition of American with British coal in neutral markets that we look for appreciable relief of the present situation, and a safeguard against any future rises. Our readers need no telling that the scarcity of coal in the home markets during the past 12 months has been in no small measure due to the increased export of our coal to other countries. If, therefore, as we have before pointed out, the demand of those other nations can be met by shipments from America, every ton so supplied releases a ton of English coal for sale at home. And that very desirable consummation is now being brought about to a steadily growing extent.

"Italy has received numerous cargoes of American coal; and a Newport collier has delivered over 3,000 tons at Cronstadt—the first cargo of U.S.A. coals placed in Russia; France is about to receive seven cargoes from Philadelphia, and the representative of some American collieries, who appeared on the Coal Exchange last Friday, reported having concluded a contract for the delivery of 100,000 tons at Havre.

"What with the competition of American goods with our iron and steel manufactures—as to which we have something to say elsewhere—and of American coal with British in the Home and Continental markets, we shall soon have to celebrate another relief—the relief of the coal consumer."

A GUILD DIVERSION.—"F," who is of those who are all right, sends the following account of the last outing of the Guild of Gas Managers—he put in an acid reminder in the enclosure by the way that there was room and welcome for more of the New Yorkers than those who reported:

"One of the pleasantest trips ever enjoyed by the Guild of Gas Managers occurred on Saturday, September 1st, when, on invitation of Mr. A. C. Burrage, its members passed the day at his beautiful camp, 'The Needles,' at South Hanson, Mass., not the least sparkling spot in the confines of Plymouth county. The party numbered about 40, and left Boston in a special car attached to the 10:40 train. On reaching South Hanson they were met by drags and had a most enjoyable three-mile drive over woodland roads to the camp. It would be difficult to imagine a more charming spot. Located deep in the heart of the woods, surrounded by lofty pines—from whose needles it takes its name—the camp stands on a knoll overlooking one of Massachusetts' most beautiful lakelets. Colored to blend with the woodland tints, and everywhere enhanced by the florist's skill, the whole effect is so ideal that one for a moment wonders if he has not dropped idly his favorite poem in his lap while he dreams with the poet of a 'Lodge in some vast wilderness.' The sports were unusual. Four fat men gave an exhibition, not only of themselves, but of how not to play tennis, their scheme being to swat the ball as far as possible so as to have longer rests between plays. A camera fiend took a picture of the party, entitled 'called down,' most of the party kneeling. This is positively their last appearance in this role; and the fiend was 'trun down' afterwards in consequence. One of the party shot the chutes after committing his sole to its maker and his watch to 'Harry,' which latter precaution was deemed unnecessary, as missing watches are always found in his pockets. Swings, quoits, tilts, football and finally dinner, perfectly planned, perfectly served and heartily enjoyed with appetites born of the woods. With the exception of a word of welcome and a word of appreciation in return, no speeches were made. King Richard III. appeared to an audience 'composed' of the camera man before alluded to, and killed the base tyrant to tumultuous applause. After music, in which the Guild took blue ribbon honors, the homeward trip was made; all agreeing that a perfect host, a perfect spot, a perfect day and, shall we say it? a perfect party are sure to make a perfect time."

Impressions of Small Gas Works in Ireland.

[A paper read by MR. PERCY GRIFFITH, at the Sligo meeting of the North of Ireland Association of Gas Engineers.]

My only excuse for presenting the following notes on Irish gas works to a body of Irish gas engineers is that I have undertaken this very formidable task at the urgent behest of your president; and I can only hope and believe that such an excuse may serve to mitigate the severity of your criticism, as well as to justify your giving me a patient hearing. My reluctance to attempt a paper on this subject was the greater because of the comparatively few opportunities I have had for making a special study of Irish gas works generally, as distinguished from English works. If, therefore, my knowledge of them should appear somewhat superficial to Irish engineers, or my conclusions in any way unwarranted, I must ask you to give me freely such correction as may appear to be necessary in the course of the discussion.

It will be best in the first place to explain that last summer I made an extended tour, chiefly in the western provinces, for the purpose of reporting upon the value and prospects of a number of small works, which, owing to various causes, but principally the want of capital for extensions, were in a more or less stagnant condition, as well as for the purpose of inspecting various small towns where there appeared to be good openings for the establishment of new works. I need hardly say that my tour proved extremely interesting and instructive, more especially as I had the company of your president most of the time.

I propose to divide my paper under sundry heads for convenience of reference and discussion; and as the time at my disposal has been extremely limited, I will confine my remarks within the shortest possible compass.

Ownership of Undertakings.—I was throughout my tour very much struck by the number of works in the hands of individuals, as well as by the absence of that competion between local authorities and companies, which is, at the present time, so important a factor in English gas undertakings. The first point is, in my opinion, a serious disadvantage in many respects, and one not easily accounted for, unless it be due to a want of enterprise on the part of engineers and capitalists generally. The results are, however, very obvious and decidedly antagonistic to that progress which you, as gas engineers, have very much at heart. The private owner, having but a limited supply of capital, and being naturally adverse to investing the whole of it in one undertaking, has neither the means nor the desire to extend and develop his works and mains except so far as can be done from time to time with surplus profits—that is, with whatever balance remains after paying himself a fair minimum interest on his invested capital.

Under such conditions, it is obvious that any development on modern lines—such as, for example, the hiring of stoves, fittings, and slot meters—is utterly impossible; and, consequently, in those works owned by individuals a restricted supply and high charges are the rule rather than the exception.

The non interference of local authorities with the supply of gas to their constituents has no doubt been accounted for in the past by the absence of local representation on those bodies as it is understood in England; but no doubt the recent creation of county and urban district councils will very shortly make a difference in this respect. At the same time, I think few engineers and managers will look forward with satisfaction to a time when local authorities shall consider the ownership of gas works within the ordinary scope of their duties, and make a general practice of buying them up at the lowest possible figure. In my opinion, this policy, whatever its advantages may be, would not conduce to that peaceful advance of scientific improvement which alone can secure the best quality of illuminant at the lowest possible price.

Capital.—As far as my observation has carried me, this may be considered the vital point in connection with the gas industry in Ireland. Whether I am correct or not, you will be able to decide more definitely and reliably than I can. In nearly every case I investigated, whether gas works were already in existence or not, the difficulty appeared to be the same—viz., how to raise sufficient capital either to construct or to extend the necessary works and mains, and this notwithstanding the fact that every existing undertaking was paying a very fair percentage of dividend or interest on capital invested. That there is an absence of capital in Ireland has been most positively denied by very competent authorities; and I must, therefore, abandon any attempt to explain what is, to my mind, the most serious bar to progress in the industry we are all so deeply interested in.

Even in the case of small limited companies, I found it quito a com-

mon practice to utilize surplus profits (when made) for the necessary extensions of plant or mains, rather than to raise additional capital for the purpose—a practice which, although improving the security for the original capital from year to year, and maintaining a low proportion of capital, must be fatal to that expansion of the business by which alone it can be rendersd prosperous and secure. The rates of charge prevailing among the small works, and the absence of any engine, stove, or meter business, may, I think, be taken as more or less direct results of this system.

Accounts.—The practice above referred to naturally produces a form of accounts which is very puzzling to one unaccustomed to it. Of course, it does not follow that this is necessarily misleading to Irish accountants or Irish shareholders; but it must at least be granted that balance sheets based on this system do not give an accurate representation either of the actual capital value or the net maintainable profit of the undertakings to which they refer. Consequently calculations for ascertaining value are extremely complex, and largely depend for accuracy upon information not to be found in the balance sheet at all in many cases.

No doubt the peculiar and very various forms in which gas accounts are kept in Ireland arises partly from the absence of any common form, such as is provided in the Gas Works Clauses Acts; and I will therefore turn for a moment to the question of

Parliamentary Powers.—To an English engineer, the absence of any statutory powers, except among the largest works, appears very remarkable, and bears ample testimony alike to the reasonableness of the road authorities in regard to main laying and repairing, and to the honesty of the consumers in accepting (and, presumably, meeting) a liability not enforceable by parliamentary authority. In my opinion, however, it would materially assist the development of tho gas industry in Ireland if parliamentary powers were more generally obtained. In the first place, the adoption of the General Acts would secure uniformity as regards account keeping and general financial management, as well as the quality and supply of gas. The general stability afforded by parliamentary sanction and support would also strengthen the financial position of any particular undertaking, and render the raising of capital more easy than it now is. Further, the restrictions in respect to the price of gas would certainly prompt owners and managers to adopt the most improved systems of manufacture in order to reduce the cost to a minimum. And, finally, the annual returns as to capital, loans, gas made and sold, profits, price charged, etc., required of all authorized gas undertakings, would, I think, prove of inestimable value to all gas engineers.

While dealing with this subject, I must, however, refer to the extravagant cost incurred in obtaining parliamentary powers under the present system, which requires promoters, opposition, and witnesses alike to travel to London and back in order to secure a hearing. It can hardly be expected that parliamentary powers will be generally sought by the smaller gas undertakings while the trouble and expense are as excessive—and, apparently, unnecessarily so—as they now are; and it is earnestly to be hoped that Parliament may soon see its way to bestow upon Ireland the privileges in this respect recently conferred upon Scotland—viz., that of having the details of all Private Bills settled in the Capital City.

Condition of Works and Mains.—The general condition of the smaller works will no doubt be better known to you than it is to me; but I think I may fairly deal with what I myself saw, and leave you to judge how far this state of affairs is general throughout the country.

Buildings.—With regard to buildings, I may say at once that they were generally of the most substantial character, and in a remarkable state of preservation, even when obviously old and neglected. The natural supply of limestone, and the practice of making all walls about 2 feet thick, no doubt account for this.

Land.—The works I visited were nearly all very favorably situated as regards land, having ample space for extensions, both on the existing sites and adjacent thereto. The system of land tenure is, of course, different to that common in England, and is usually based upon a very long, sometimes interminable, lease at a nominal annual rent. It is not within the province of this paper to deal with this subject, as it varies but little from the English freehold tenure. The price of land is, however, generally extremely low; and there is less difficulty in getting convenient sites than is the case in England.

Retort Settings.—These are almost universally of the ordinary type; regenerators are extremely rare. Machinery for drawing and charging is also entirely absent from the smaller works; and, in fact, the general design of settings, retorts, and fittings is often of the most anti quated type. Retorts of cast iron, as small as 13 in. by 13 in. by 7 ft. long, in arches containing one, two or three retorts each, are not uncommon; and in some cases, the whole of the coke made is consumed in the furnaces. It is obvious that where such conditions prevail, an exorbitant charge per 1,000 cubic feet is necessary to secure any return for the capital invested. The gas made per ton of coal is also, of course, much below what it should be; and the capacity of the retort benches, too, is small proportionate to their original cost.

Condensing, Washing and Scrubbing and Purifying Plant.—The general plant of the works I visited was in many cases extremely inefficient, and suggested that a test of the gas would have revealed a very undesirable state of affairs. Very rarely was any attempt made to collect or utilize the ammoniacal liquor, although tar was generally sold, in small quantities relatively to the coal carbonized, at a good price. Exhausters and washers were also rarely met with; and the working results will, therefore, be readily imagined without further data.

Storage.—The gasholders were invariably small and in want of repair, and the tanks leaky—in fact, at one works the holder was erected in a pond formed by filling an old stone quarry with water; the guiding columns being erected on separate piers built on the floor of the quarry. The holder itself was, therefore, practically inaccessible except by boat or raft.

Mains.—Mains were perhaps the most deficient part of the various works, being small, leaky, and never carried as far as would have been warranted by the demand. In some cases, public lamps were supplied by small service pipes extending several hundreds of yards, where a little canvassing would have secured consumers *en route*, and have justified the laying of a proper main.

Generally.—Of course, the foregoing remarks must not be taken as necessarily involving all the small works in Ireland, or even all those which I inspected; neither do I mean to imply that where such conditions as I have indicated prevail, the fault lies with the managers. The general difficulty appears to be in raising the necessary capital for properly extending and developing the works; and it is small cause for wonder that, in such circumstances, capable managers are difficult to procure, and more difficult to keep.

Price of Gas.—I have already referred to this point, and need hardly repeat that, under the conditions which I have described, a low rate of charge is obviously impossible if any dividend or interest is to be made on the capital invested. Rates of $1.25, $1.50 and $1.75 per 1,000 cubic feet are not at all uncommon, and special rates for cooking stove or engine supplies are by no means general—in fact, it was evident that many of the works would have been totally incapable of meeting any such additional demand for gas as these supplies would have created; and as in these cases it would certainly have paid to reduce the price of gas, apart from any reduction in the cost of manufacture, it is clear that incapacity to meet the increased demand which such a lowering of rates would have produced, was the real reason for the maintenance of the high charges. I may, however, say, with every confidence, that in no case investigated by me was the charge made for gas warranted. In other words, a trifling capital outlay would invariably have produced such a reduction in the cost of manufacture, and such an increase in the capacity of the works, that a lowering of the charge would have been eminently feasible without any sacrifice of profits or dividends—in fact, these would, I am confident, have been increased rather than diminished by such a progressive policy.

Stoves, Fittings and Slot Meters.—It need hardly be said that the modern practice of hiring stoves and fittings, and of doing so by means of a fixed scale of prepayment based on the consumption of gas, has not yet reached any of the smaller Irish works. The comparatively heavy capital charges involved in this system are quite sufficient to account for this as matters now stand; but it is earnestly to be desired that some means may be found to overcome the difficulty, alike in the interests of the smaller consumers and those of the gas industry generally. The advantages of this system have now been fully proved in England, both in large towns and rural districts; and granted the necessary capital, there is no reason whatever why it should not prove equally successful in Ireland.

Residual Products.—Tar.—The manufacture of tar for sale appears to be very much neglected in the works I visited—and that in spite of the fact that there was generally a good demand for it.

Liquor.—As previously stated, the liquor was in most cases thrown away; and one could not help remarking that there seemed little difficulty in turning it into the nearest ditch or water course—a state of affairs which is now very rare in England. It is propable that the newly constituted local councils will shortly begin to interfere with this in the interests of those relying on such sources for their domestic

water supply, in which case it will be necessary to pay a little more attention to this very valuable product than has been given it up to the present. In an agricultural country such as Ireland, it would seem that sulphate of ammonia would fetch a very good price; and I believe it does so, although I have not the actual figures before me. The only difficulty appears to be in the case of the very small works where separate sulphate plants would hardly pay; and for these, I would suggest the erection of small concentrating stills at the works themselves, in order to reduce the bulk of the liquor for carriage to the nearest sulphate works. Such works could then be erected very profitably at convenient centers within easy reach of the smaller gas works on the one hand, and shipping ports for export of the finished product on the other.

Coke.—As regards coke, I need only call attention to the desirability of increasing the amount available for sale per ton of coal carbonized to the utmost, as in every case a good price could be obtained locally. Moreover, with the recent development of water gas plants in the larger cities, there is likely to be an opening for coke at a paying price there, which has, of course, not existed before.

Openings for New Works.—In conclusion, I may add a few remarks upon the scope that exists in Ireland for the erection of gas works in the small towns hitherto neglected. I have, as previously stated, visited a number of such places, and, by personal inquiry, have satisfied myself that a gas supply would be cordially welcomed, and immediately adopted, by the principal shopkeepers. In most Irish towns, there are either convents, workhouses, gaols, or court houses, as well as other public buildings and offices, that would become large consumers of gas; and every gas manager will appreciate the value of the "large consumer" to a small undertaking. The only thing needed is apparently that so often referred to in this paper—viz., the necessary capital, coupled, of course, with such enterprise, energy, and engineering skill as are necessary in every manufacturing concern of a similar nature. The last mentioned is also peculiarly necessary at the present time, when gas making is being elevated into a fine art, and the chemical processes involved are every day being more closely investigated and more and more scientifically carried out.

Let me, before closing, once more apologize if I have seemed to depreciate the gas industry as practiced in Ireland too severely, or more than is warranted by the facts. It will be sufficient for my purpose if I have drawn the attention of your Association to the splendid opening that your country affords for the development of your own particular business among the smaller towns; and I hope that the suggestions I have thrown out will not seem too presumptuous coming from an English engineer with so much less experience of Irish gas works than you have yourselves. Should this be the case, I can undertake to accept your criticisms with a perfectly open mind, being confident that the time taken in studying this important subject will not have been in any sense wasted.

Discussion.

Mr. S. B. Langlands (Coleraine) said that in Mr. Griffith's paper they had an excellent lever with which to move gas companies and corporations to a new order of things. It seemed to him that Mr. Griffith had a thorough grasp of the difficulties gas managers had to contend with; and he thought the Association should accord their best thanks to the author for his valuable communication. If at any time they wished to bring before their companies or corporations any questions as to extension, reduction in price, or anything of the sort, he was convinced that they had in the paper the very best means for moving them.

Mr. S. A. Scrivener (Dublin) thought that they certainly had before them one of the best and most important papers which had been read to the Association for some years. More than this, they had at Sligo one of the best examples of what could be done when suggestions such as those contained in the paper were followed up. The President had spoken of a 60 per cent. leakage, and what he had done to reduce it; he had also told them something about the difficulties he had had to contend with. In no walk in life could they earn money without spending it. This was particularly true in the gas business; because if they tried to make gas upon the lines on which it was made 30 or 40 years ago, they would be clean out of it. In view of the newer competitors they had, in the shape of electric light and others which had sprung up, they required to produce more gas, and to have more lights burning. The President had done this. He had been doing what they should all do—seeking to provide gas for various purposes, and at a price which would enable the people to avail themselves of its advantages. He had succeeded in making much more gas, with practically very little addition in the way of charges. His management of the gas works in Sligo had been a great success.

The Design of Coal Pockets.

Engineering Record notes that in the number of the "Proceedings of the American Society of Civil Engineers" for last month there appears an interesting paper by Mr. L. G. Montony on the "Ninety-sixth Street Power Station of the Metropolitan Street Railway Co. of New York." In this paper he gives an account of the methods followed in designing the coal pockets which supplements the description of them in an earlier issue of the *Engineering Record*. In this connection it should be added that a number of articles on this interesting power house have appeared in these pages, among them the following: "New York's New Chimney," on December 17, 1898, and "The New Power Station for the Metropolitan Street Railway Company" on December 22, 1899. Mr. Montony's notes on the coal pocket design are as follows:

The large coal pockets presented quite a problem. This tendency to burst or spread out is resisted entirely from the outside, there being no exposed iron whatever in them. The pockets are lined with I-beams spaced 2 feet or more apart and varying in depth from 10 to 15 inches. These are filled in with concrete which is carried to about 3 inches over their tops and then covered with waterproofing material. The concrete surface was left fairly rough in order to prevent the waterproofing from sliding or peeling off. The section of the pockets is shown in the accompanying cut and the ends are vertical.

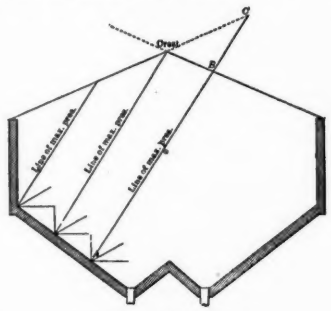

Diagram of Coal Pocket.

The pressures, of course, are calculated for a maximum load, the conditions for which are that the pockets shall hold as much as they can be made to by trimming; that is, that the coal should slope up from the tops of the vertical sides at the angle of repose to the summit. The pockets can be filled by the conveyors almost to this limiting line.

The pressures on the vertical surfaces were calculated by Rankine's formula for a retaining wall with superimposed loads:

$p = wx \cos \Phi$

in which p = pressure on a unit of surface,

w = the weight of a unit of volume of the material,

x = the depth below the top of this unit of surface,

$\cos \phi$ = the angle of repose of the material, or the angle of the top slope.

The pressure is parallel to the surface of the material. Then the total pressure on a vertical surface is

$$P = \left(\frac{D^2 - d^2}{2}\right) w \cos \Phi$$

where d = the depth of the top of the surface, and D = the depth of the bottom of the surface below that point in the top surface of the material directly over the surface.

The weight of a cubic foot of coal was assumed at 56 pounds.

The pressures on the inclined side portions were obtained by considering each surface as composed of a series of steps, and assuming the pressure on the slope to be the resultant of the vertical dead load multiplied by cos ϕ on the horizontal part of each step, and the thrust on the vertical part as calculated by Rankine's formula.

The calculated pressures on the vertical faces of these steps were reduced when the so called line of maximum pressure—that is, the line bisecting the angle between the vertical and the slope of repose—cuts beyond the crest of the coal slopes; that is, intersects the opposite receding slope, or that slope produced, first instead of the rising slope, and by the amount that the part $B\,C$ of the line between the opposite receding slope at B and the ascending slope at C produced, bears to the whole line, up to the ascending slope line produced or $A\,C$.

In the bottom of the pocket, the two slopes of the crown piece count

eracted each other, and therefore it was only necessary to make the V-pieces strong enough to resist this pressure, and the main cross girder only strong enough to bear the vertical load and the tension induced by the side pressures. At the height where the bottom of the vertical portion meets the top of the inclined part there is a horizontal trussing, made strong enough to carry a large portion of the lateral thrust to the corners, and the corners are made strong enough to resist a powerful distorting force.

Across the end of this level there are horizontal trusses strong enough to take the entire end thrust to the corners and thence down the sides where it will be taken up by the frictional resistance of the coal, or, if the pocket is full, it will be partially resisted by the opposite end pressure transmitted along the side pieces. This was done to provide against any possible bursting tendency of a sudden settlement, one-sided load, or other cause; even for the remote possibility of a slight earthquake.

The strains on the steel and the loads on the columns and brickwork were made to agree with those allowed by the Building Department of New York city by the law used in 1898, before the present law went into effect.

Observations on Retorting and Condensing Temperatures.

[A paper read by MR. FORBES WADDELL, of Forfar, at the Edinburgh Meeting of the North British Association of Gas Managers.]

Calculating on bases supplied by respected authorities, it is found that, even in the best forms of regenerative settings, the coke required to gasify one ton of coal has a calorific value of 4,914,000 B.T.U.; while the amount of heat required to gasify the ton of coal is represented by 809,760 B T.U.—less than one sixth of the value is used for its proper purpose. There is, of course, to be reckoned the heat energy lost in getting through the material of which the retort is made, and the maintenance of the internal surface of the bench walls at the same temperature as the retorts, etc. But even allowing a reasonable amount under these heads, there is certainly a great quantity of heat wasted or badly applied in retort houses.

In the first place, the retort houses are kept warm at the places where the men have to do the hottest work. But we are prone to get used to things not being as they should be; and, though we admit that there is a lot of heat expended on the men and their surroundings, we have to be content with the conditions. These conditions are, however, unsatisfactory; for they are evidence of heat badly applied at the best, or altogether wasted. "Altogether," of course, refers to heat expended on floors, walls, roofing, and the air which at times rushes very rapidly over the bench surfaces; and "badly applied" is suggested to me by coals being dried in front of retort benches in winter. The latter instance, perhaps, looks somewhat of a paradox; but when it is considered that the coal must be kept more than 20 feet from the source of heat, one must admit that the drying is done at great expense, though it is certainly better than letting the heat radiate on to the wall. Retort house walls, to my knowledge, sometimes get too hot for the hand, though there are many openings in the walls of the house referred to. On the other hand, the mouthpieces of retorts in action sometimes get cold enough to handle.

In considering whether a remedy, or a partial remedy, can be found, this occurred to me: In a setting of brick built retorts 4½ inches thick, with a 4½ inch front wall, there is never the least tendency on the part of the front surface to become red hot; though it is observed that, at the end of a charge, the retort is a bright red. Further, the same temperature is applied to the brick retorts as to the front brick wall; and, therefore, if a door were put over part of the front wall, that part would soon get red hot, and would keep so as long as the door was shut. The door being closed only keeps the air off that part of the wall; and the two results are: (1) bricks get red; (2) air passing over that part is not much heated.

Here, however, another point occurs to me. Say that there is within the setting (I have not attempted to use thermometers therein) a temperature of 2,000° F., and at times the hand can be put on the mouthpiece. Then there is a difference of nearly 2,000° between the temperature surrounding the retort and that round the mouthpiece; and though the latter is seldom so cold as to be handled, there is at all times a very great difference, which must mean a rapid fall in the temperature of the products of the distillation of the coal.

From a very early period in the history of gas making, managers have been exhorted to cool such products very gradually; and the importance of doing so is being brought home now with more force than ever it was in the past. It is no new thing to take the gas out of tars. There have been many ways, of which I presume the most outstanding are the Dinsmore and the Peebles processes. Both have shown remarkable results. Mr. Isaac Carr, of Widnes, in a paper read before the Manchester District Institution of Gas Engineers, stated that by passing the distillation products, on their leaving the retort, through a heated duct, the quantity was increased 10 per cent., and the quality by 4 or 5 candles. From the distillation of one ton of tar in the Peebles plant, according to Mr. Bell, there are obtained about 15,000 cubic feet of 25-candle gas and 15 cwt. of excellent coke.

In Blairgowrie, I made some slight alteration of the fittings of a setting of three retorts with the view of condensing as much tar as possible, and returning it to a specially heated part of the ascension pipe; and the result was so good that at the time I was sceptical, but was ultimately quite satisfied as to their accuracy. It has, therefore, been interesting to me to further experiment with these two points before me: (1) The saving of heat and returning it to the setting; and (2) cooling the products of the distillation of the coal more gradually. My aim has been to bring about a single retorting the gasification of as much of the coal products as possible, with the lowest expenditure of the coke produced; and these modifications have suggested themselves to me, and been carried out from time to time.

The temperature of the gases surrounding the retort being (say) from 1,800° to 2,500° F., and that of the air playing about mouthpieces and ascension pipes from 50° to 100° F., there is, in addition to the sudden cooling, a great fluctuation—more sudden as the temperature of the atmosphere falls, and improving as it rises. This fluctuation is from day to day and from season to season.

The experimental plant was, to begin with, an iron retort, 3 feet long by 7 inches in diameter, and other plant corresponding. The first help to more gradual cooling that suggested itself was a larger ascension pipe, giving increased duration of travel from the retort to the hydraulic main, and thereby, according to our best authorities, giving gas of increased illuminating power. The first arrangement had the stand pipe 1½ inches diameter, and it was substituted by one 3 inches diameter, provided with a cooling vessel at the top (see Fig. 1).

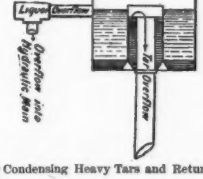

Fig. 1.—Arrangement for Condensing Heavy Tars and Returning Them to Mouthpiece.

At this point, I cannot refrain from saying a few words on my experience of different diameters of ascension pipes, the choking of which has given most managers some trouble. First, they are simply a means of conveying gases and vapors from the retort to the hydraulic main; and although those who are troubled with chokes in them might well reason, even from a mechanical point of view, that, if there was more room for pitched tars, there would certainly be fewer chokes, still the pipes I come across are not being much increased. In addition to the extra area, there is greater cooling surface. An 8-inch pipe, for instance, has an area of fully 50 square inches compared with an area of $23\frac{7}{16}$ square inches in a 5½-inch pipe. The comparative rates of travel through 5½ inch and 8 inch diameter pipes are as their areas; so that the cooling efficiencies of the two are (respectively) 409 and 12,600—that of the 8-inch pipe being three times that of the 5½-inch pipe. One thing that change has brought about is the complete absence of chokes. I have not had a choked ascension pipe for five years.

In very cold weather, however, even with high heats, there is liquid tar on the mouthpieces—evidence that a great quantity of hydrocarbon vapors is being condensed in the mouthpiece, where the temperature is much greater than in the hydraulic main. At other times, with no better heat in the setting, but with warmer air round the mouthpieces and ascension pipe, the former is quite dry; and from the tar coke on the mouthpiece, it is evident that a good deal of tar has been gasified.

The last modification I have made is one that, while controlling the temperature of the air round the stand pipes, returns to the setting the air which, in cooling the ascension pipes, mouthpieces, and bench front, becomes itself heated. Fig. 2 illustrates the setting and ascension

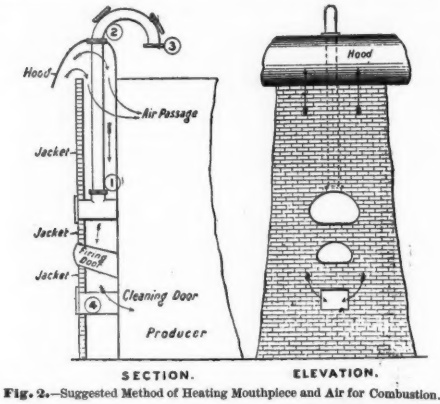

Fig. 2.—Suggested Method of Heating Mouthpiece and Air for Combustion.

pipe covered with sheet iron in such a way that the chimney draws all the air needed for the producer and combustion chamber down between the bench surface and the bench front covering. The advantages of this are two: (1) There is, in the first place, brought about that desirable gradual reduction of temperature, or the cooling is at any rate more gradual; for, instead of the air first getting into contact with the mouthpieces when at its coldest, it commences to cool the top of the ascension pipe, and as it gets warmer, descends to cool the mouthpieces and, indirectly, the distillation products. That order of things—the cold air first cooling at the top—means the falling out of a greater quantity of heavy tars than is the case in ordinary practice; and, further, it means the retention of hydrocarbons in their gaseous state at the mouthpiece, by reason of the air coming into contact with the mouthpiece being first heated, and on that account not cooling the coal products so rapidly. (2) The other advantage is in the air, thus heated by contact with the ascension pipe and mouthpiece and with the bench walls' surface and the inside of the covering of bench front, being still further led over the bench surface, till, when entering the producer and secondary air flues, its temperature has been increased from (say) 70° to 500° F.

The result of this arrangement, considered in relation to better results in make and quality of gas, is tabulated side by side with results from the plant under the other conditions already mentioned. The saving of coke was quite appreciable, even with the experimental plant; and in view of this, the figures for coke saving per ton of coal carbonized may interest you. Counting on each ton of coal producing 13 cwt. of coke, and allowing that 25 per cent. of the coke made is required to keep up the heats, we have $\frac{13 \times 112 \times 25}{100} = 364$ lbs. of coke used per ton of coal carbonized. Say that each pound of coke reqnires for its combustion only 12 lbs. of air—not much more than the theory figure—the amount of air required for firing per ton of coal carbonized is: $364 \times 12 = 4368$ lbs. The specific heat of air being 0.238, and all the air required for combustion, 4368 lbs., being heated through a range of (say) 430° F., then the heat given back to the setting in this way means—

$$4368 \times 430 \times 0.238 = 447{,}020 \text{ B.T.U.}$$

That is a saving in coke at the rate of 33 lbs. per ton of coal carbonized; and I may say the estimate is very moderate, as the air was heated to the extent calculated by taking back only the air which had heated the front furnace, while the air heated in the remaining furnaces was allowed to escape through the roof. A further disadvantage with this experimental plant is that the jacket protecting the bench front is of thin sheet iron, which is not a good non-conductor. I have not had a brick covering tried; but I have no doubt it is quite applicable to a working setting, in which case I believe a temperature of about 700° F. could be maintained above the mouthpiece. Such a saving as would result from tars so heated is gauged to some extent by the improved results Mr. Carr realized with the Dinsmore process; and the sale of coke per ton carbonized would be increased to the extent of about 60 lbs. No doubt those figures are good, and I have not obtained them in practice; but the experiments have been carried out under fairly disadvantageous circumstances, and the results given in Table III. can, I am sure, be improved by arranging a practical setting.

Anything I have up till now said about temperature does not specify the actual degree unless in one case; and I may further state that, on account of the unreliableness of thermometers for high temperatures, I made no attempt to use them inside the setting. But the heats were very carefully regulated so as to work off to the same color charges of the same weight of the same coal from the first test to the last one.

The quantity of splint nuts used in each test was 1½ cwt.; and the results here given are just as found:

Observations on Retort and Condensing Temperatures.

I. Ordinary Plant. Temperatures, Degs. F.					II. Enlarged Ascension Pipe. Temperatures, Degs. F.					III. Large Ascension Pipe and Bench Front Covered. Temperatures, Degs. F.				
Hour.	1 Mouthpiece	2 Top of Standpipe.	3 Hydraulic Main Outlet.	4 Primary and Secondary Air.	Hour.	1 Mouthpiece.	2 Top of Standpipe.	3 Hydraulic Main Outlet.	4 Primary and Secondary Air.	Hour.	1 Mouthpieee.	2 Top of Standpipe.	3 Hydraulic Main Outlet.	4 Primary and Secondary Air.
6	185	80	110	66	6	184	70	112	68	6	350	82	86	440
7	180	84	144	70	7	240	80	104	70	7	346	90	128	420
8	172	89	134	69	8	240	84	134	70	8	348	90	134	428
9	185	93	130	66	9	204	86	130	66	9	350	91	140	440
10	184	92	132	64	10	222	88	140	65	10	352	92	160	460
11	234	94	156	62	11	184	86	144	63	11	355	80	158	460
12	193	84	150	60	12	190	90	146	63	12	348	88	156	462
1	190	78	144	58	1	192	82	144	60	1	330	90	148	468
2	184	82	146	60	2	200	80	142	58	2	327	88	144	450
3	178	78	140	60	3	220	82	140	60	3	320	86	140	456
4	170	76	138	60	4	190	78	140	62	4	320	86	148	440
5	212	90	150	62	5	188	78	142	60	5	326	88	160	442
6	204	92	152	64	6	190	88	144	62	6	330	90	156	450

IV.—*Results Compared.*

	Tar Made per Ton. Gals.	Gas Made per Ton. Cu. Ft.	Illuminating Power. Candles.	Sperm Value. Pounds.	Coke Saving. Per Ton.
I. Ordinary arrangement	13¾	9,150	16.8	527	..
II. Standpipe enlarged	10½	9,300	17.5	634	..
III. Ditto, and bench front covered	10¾	10,750	19.9	733	33 lbs.

Temperatures marked 1, 2 and 4 refer to atmosphere; and those marked 3 are for gases. The points at which these were taken are shown on Fig. 2.

The temperatures given in the various tables are actual themometer records. My reason for given them is to show the effect of temperature on the quantity and quality of the gas, and on the quantity of tar deposited in and beyond the hydraulic main. In ordinary retort house conditions, these temperatures fluctuate and do much harm, and control of temperatures by chimney draught or by valves let into the bench covering could, with careful working, mean better and more gas, more coke sold, no worry with choked pipes, and much better working conditions for stokers.

Trusts and Their Relation to the Engineer.

Iron Age says that the effect of the formation of the consolidations upon the engineering profession has been discussed before the Civil Engineers' Club of Cleveland by Charles H. Wright, who uses the somewhat odious term of "trust," which is hardly applicable to the organizations in the iron and allied industries. The paper has been printed in the Journal of the Association of Engineering Societies, from which we quote the following passages:

As you know, there has recently been formed a combination of the bridge builders. At first glance it looks as if this trust must have a disastrous effect upon many engineers. As we look more closely the county commissioner appears to be about the only one hurt, and perhaps engineers will not feel called upon to worry about the county commissioner.

Those of you who are bridge engineers do not need to be told that a very great saving can be brought about in the management of the bridge companies by the consolidation of the competing plants. Where perhaps 20 designs and estimates were made for the same work under the separate management, only one or two are necessary when the different plants are united. This seems to point to a reduction in the number of engineers employed. So far as the bridge companies are concerned this is probably the case. There is another side, however.

The cream of the structural work comes from railroads. At present, by simply asking for bids on certain work the railroads get the benefit of the knowledge and experience of the engineers of the several bridge companies asked to bid. It cannot be expected that the same number of designs will be submitted by the trust. On the other hand, the railroad engineers will hardly accept without question whatever may be offered by the trust. A certain amount of preliminary designing must be done. If the trust decides that it will no longer maintain a free engineering bureau, the railroads will be compelled to do this work themselves. Many of them are already doing it. If they take the wiser course and turn this work over to the engineering firms who make a specialty of this work, a long step will have been taken in the direction of economy, good design and sound common sense. The men who have gained knowledge and experience by years spent in the offices of the bridge companies will find plenty of opportunities, either with the railroads or in the office of the expert.

Incidentally, it might be remarked that the bridge trust itself has not a pathway strewn with flowers ahead of it. As stated above, the most desirable work comes from the railroads. Does anyone imagine that the railroads will allow the bridge trust to dictate prices to them? When prices reach a certain point the railroads will build their own bridges. Some of the larger companies are in a position to do this at any time. It will be interesting to watch developments in the bridge trust for the next year or two.

The American Steel and Wire trust for a little time has bid fair to rule a certain line of manufacture. Now the construction of new and independent mills is probably a certainty, and it is not probable that the new plants can ever be controlled by the wire trust. This means very much to the engineers. The new plants must be the most perfect that ever have been erected. The ability and the genius of the inventive engineer will be taxed to the utmost. Consider for a moment how far reaching this single new interest will be in its effects. Engineers in every branch will find opportunities here. If the new supply exceeds the demand, it simply means that new uses will be found for these materials; there is a vast field yet open in this direction.

At one time the ore and coal shipped from the great lake ports was handled by laborers; then came the machines for handling these materials, and the laborers lost their employment. The increased economy in handling, combined with other causes, increased the production of iron and steel, and many more men were soon required than had been replaced by the machines. Perhaps the new requirements were for a higher grade of labor, but there is no law against the laborer fitting himself to do a higher class of work. The country is full of opportunities for men to obtain an education and a training for better things. When the dock laborers were replaced by the machines skilled machinists, draftsmen and engineers were required to build the machines. New boats and new lines of railroads were built to transport the raw materials and the finished products. New furnaces and new mills were built. New machines and new devices for the economic handling of material at the mills and furnaces were required, and an endless line of improvements followed all through the iron and steel industries and the allied lines of manufacturing. All this gave employment to the engineer.

No truth seems harder for the American people to understand and yet no truth is susceptible of more perfect demonstration than is the fact that any advance in the industrial world which cheapens the cost of production or increases the possible output is in the end a direct benefit to all classes. The world always has been, and always will be, a hard one for the aged and the incompetent. We all realize and regret this, but is it advisable to limit the speed of all to the capacity of the most feeble?

"Through the ages one increasing purpose runs,
And the thoughts of men are widened by the process of the suns."

Much of the complaint about the trusts would cease if men would recognize that changes must come in methods and means, and that they must fit themselves to become valuable elements in the readjustment.

You hear on all sides complaint that the trusts and large employers strive to specialize and limit the lines of individual labor. There is complaint that there is no longer opportunity for men to become proficient in several branches, to become good all around men. This claim is utterly without foundation in fact. Never have the opportunities been greater. The desire, however, seems lacking. Watch the construction of some large building. One man must lay the bricks; another must plaster the walls. The man who puts up the steel frame must not put in the wooden floors. If the plumber wants a bracket here and there the carpenter must be called, but he must not put in the broken pane of glass; the glazier must do this. If the carpenter takes off a few slate on the roof he must not put them back; the roofer must be recalled, and so on all through the construction. If the aim of the laboring men is to see how useless, valueless and helpless they can make themselves, they must be succeeding beyond their fondest hopes. These one idea men are most loud in their complaint that the employer takes them at their word, and treats them accordingly.

Again, we hear of men being forced out of business, compelled to sell out or join a combine. No doubt many have been compelled to do this. On the other hand many men who have been struggling along for years, barely keeping their heads above water, have found in the trust a market for an old run down and out of date plant at a value much beyond its actual worth.

What becomes of these men, the former owners of these plants? Suppose 100 men enter a combine, and only ten of them are then required to manage the business. What will the other 90 do? Many of them are perhaps as bright and capable as the heads of the trust themselves. Will these men sit down, fold their hands and call their life work done? I hardly think so if they are Americans. Have we reached the limit of production? Have we reached the point where there is nothing more that can appeal to the wants, the convenience or the luxurious comfort of the people? Is there nothing more to be invented? Have we seen the end of all advance? No. There is plenty yet to do, and no need that any man or class remain idle.

A well known engineer recently tried to prove that the reason there were more and better engineers to-day than 20 years ago was because the engineering schools were turning out a better grade of engineers. If you place 50 trained and skilled physicians in a small country village few of them will, if they remain there, ever acquire any great wealth or fame. The opportunity is not there, and, no matter how great the physician's skill, he will find no occasion to exercise it. It is so with the engineer. While it is true, to a certain extent, that the engineer creates his opportunities, he will not make a much better showing than the physician unless he has the help that great wealth alone can give. The engineer, more than any other professional man, requires the backing of capital. The trust is in the position to give this all important aid.

We hear a great deal about the trusts increasing the prices of the materials controlled by them. Up to a certain point they can do this: beyound that point they cannot do it. You can rest assured that when they are putting the price above what is included in manufacture and a fair profit, they are paying some one else more to keep out of the business than they are making themselves. Any article that one trust can make, another can and will when there is a profit in doing so. Is it sound business policy to keep prices above a reasonoble point? Which is the successful merchant, the one who handles many goods at small profit or the one who sells a small amount at a very large profit?

The people fear the trusts because they do not understand them, and do not know that 75 per cent. of the so-called trusts will be blown to the four winds of heaven when the first breath of business depression strikes them. Imaginary profits on imaginary capital are about as satisfying as bread made from sawdust.

I may own a dog worth $2, and may form a company and sell 1,000 shares of that dog at $10 each (if I can get any one to buy them), but I have not created any wealth. I have simply transferred wealth from the pocket of some one else to my own pocket. Everything looks all right perhaps, and there is no trouble until I have to pay dividends on the shares of that dog. When that time comes then trouble begins.

In considering trusts and their relation to the engineer, I have in mind only such trusts as had some good business ground as a basis for their existence. It is true, however, that many of the bogus trusts have very materially benefited the engineer. This is the least attractive side of the subject, however. Engineers did not feel great pride in the work done by them on the wild, visionary and bankrupt schemes which marred the landscape at the Chicago Fair, for example.

While the trusts are increasing, and while laws are being made to abolish them, and while public honesty and morality are slowly being taught, let the engineer make the most of this, his golden opportunity. Without the union of the railroad interests the numerous terminal stations of the great cities would never have been built. The same is true of many other railroad improvements. All the great combines have called upon the engineer to carry on works which never would have been constructed by individual enterprise. Small independent industries have not the means to spend in experiments and the trial of new inventions. Combinations of capital stand ready to do this if

they see profit to themselves at the end. Every new invention opens the way for others, many of which require large capital to put them in operation. One might go on indefinitely citing instances where the engineer finds the door to employment, and possibly to fame, opened to him by the hand of the trusts. Without the engineer the trust is helpless. Without the trust the engineer never would see the successful completion of the grandest products of his genius.

High Voltage Incandescent Lamps.

By Prof. Geo. D. Shepardson, in *Elec. World*.

The high voltage (200 to 250 volts) incandescent lamp made its first appearance about 1892, and in a short time won for itself quite a large place in commercial practice. For several years the merits and faults of the new product were given prominent attention in the electrical journals and in less public discussions, some maintaining that such a lamp could obtain little, if any, successful use, while others believed that it would immediately find a wide adoption. As the years have passed, the lamp has been improved and has found an ever increasing use. For about two years the papers have given but little attention to this lamp, apparently for the reason that the novelty has worn off, while the lamp makers have been steadily and quietly at work improving their product.

In attempting to get a clear view of the present situation, it is desirable to recall the reasons originally urged for and against the 220-volt lamp and to inquire into the results of later development. The principal reasons urged in favor of its use were the smaller amount of copper required for conductors, the steadier light obtainable and the ability to reach greater distances. The reasons against it were principally that the lamps were of low efficiency, thus requiring a larger generating plant and more fuel, and that the lamps were not uniform. These reasons might be amplified indefinitely to cover various conditions, examples of which may be found in a paper by the writer.[1]

During recent years the lamp makers have added largely to their experience in making high voltage lamps, so that they now turn out a much better product than formerly. At the same time their business has increased to such an extent that they are better able to select lamps to suit the requirements of each customer, thus doing away with much of the earlier lack of uniformity. The growth in the 220-volt lamp industry is illustrated by the fact that one firm, which sells about 75,000 lamps annually in Minnesota and adjoining States, reports that its sales are about equally divided between 110 and 220 volt lamps, most of the 110-volt lamps going to isolated plants, while practically all of the 220-volt lamps go to central stations.

The growth in the number of central stations using 220-volt lamps is indicated by the fact that the Powers Directory for October, 1894, listed 3 central stations in Minnesota using the 110-volt system, 11 using the 110-110-volt 3-wire system, 1 using the 440-volt 5-wire system and 29 using the alternating current system. At the present time there are 9 stations using the 110-volt 2-wire direct current system, 17 using the 110 110-volt 3-wire system, 38 using the 220-volt 2-wire system, and 54 using alternating systems. During less than six years there have therefore been installed in Minnesota approximately 38 central stations using the 220-volt 2-wire system, 6 using the 110-110 volt 3-wire system and 25 using alternating systems.

The above figures are to be taken with some caution when comparing the relative advantages of the different systems, since they do not by any means prove that the 220-volt 2 wire system is so far preferable to the 110-110 volt 3-wire or to the alternating current system as might at first appear. The larger towns, for which alternating current systems would seem best adapted, were already supplied.

The patents on the 110-110-volt 3 wire system were in the hands of one company, so that the engineers hesitated to specify it, and at contract lettings there was only one company to push that system, while there were numbers urging their alternating or 220-volt systems. Again, there are certain engineers who have learned how to draw plans and specifications for 220-volt plants, but who feel loath to undertake to plan a 3 wire or alternating current system; they therefore invariably call for the 220-volt system, whether that is really best or not, like the Chinese tailor, who claimed to have received only one pattern from his god, and if his customers did not fit suits made after that pattern it was their misfortune. On the other hand, it must be admitted that most owners and customers of plants using 220-volt lamps are well satisfied with the results.

The high price of copper prevailing for some time past has had a tendency to make the alternating current system somewhat cheaper to install than the 220-volt system, so that one well known engineer has not specified a 220-volt plant for three years and has not installed one for two years, being able to put in a plant for equal capacity more cheaply with alternating current apparatus. On the other hand, the high cost of copper has led others to adopt 220 volts in cases where 110 volts would have been preferable with lower prices for copper. The large number of 220-volt central station plants installed in Minnesota and adjoining States in recent years is due partly to the high price of copper, partly to a weakness of some designing engineers already noted, partly to the desire of the owners to get in a plant as cheaply as possible, hoping that the future would take care of itself. Many hope that in installing an electric light plant they can follow the practice of the railroads which put in cheap construction at first, and then from the profits of operation gradually substitute culverts and fills for piling and trestles, iron and stone bridges for wooden structures, short cut-offs for long detours, etc. Such practice is possible to a limited extent in the construction and operation of a lighting plant, but having once adopted a system, it can be changed but little except in the way of additions without throwing it away in part or whole.

When the 220 volt lamp was first introduced and its weak points were recognized, it was claimed by many that any improvements that might be made in the high-voltage lamp would apply equally well to the low-voltage lamp, so that the former would continue to require 20 to 40 per cent. more watts per candle than the latter. The greatest difficulty seemed to be in the filament. Since a 220-volt lamp must have approximately four times the resistance of a 110-volt lamp of the same candle power, in order that an equal amount of energy may be taken at double the voltage, its filament much be of only one-fourth the sectional area, or it must be four times as long, or some compromise between the two. A lamp with a short, thick filament can be operated at a higher efficiency than one with a long, thin filament, since the efficiency increases with the temperature, and a short, thick filament continues stable at a higher temperature than is safe for a long, thin one. The 110-volt lamp can thus be made more efficient than the 220-volt lamp, for the same reason that a large lamp is more efficient than a small one Theoretically, the above is true, but not in its practical working out. The 110-volt lamp was already a commercial success, giving such satisfaction that consumers had little reason for demanding further improvement. On the other hand, the 220-volt lamp was unsatisfactory and, at the same time, there was a rapidly increasing demand for more and better lamps for 220-volt circuits. The natural result was that lamp makers gave more attention to improving the one than the other. The trouble with the high-voltage lamp was not only with the slender filament, but with its mounting, the globe and the vacuum. It was commonly found that if a high-voltage lamp burned a few hours without breaking, it was good for thousands of hours of tolerably satisfactory service.

The improvement in high-voltage lamps may be inferred from a test recently made in a central station, details of accuracy not given; 220-volt lamps of one maker fell from 15.5 initial candle power to 15.0 candle power at the end of 700 hours, with an average efficiency of 4.09 watts per candle; the trend of the curve indicating a probable life of about 4000 hours before falling below 80 per cent. of initial nominal candle power. Lamps of another make started at 15 25 candle power and fell to 13.5 candle power at the end of 700 hours, the average efficiency being 4.13 watts per candle, the curve indicating a profitable useful life of 1000 hours. This test, if reliable, certainly indicates a great improvement over the lamps tested by the writer in 1897.[1] Not only have the efficiency and reliability of the 220-volt lamp improved, but it is made in various sizes as small as 8 candle power, and the price has fallen until it costs only about one-tenth more than a similar 110-volt lamp, as against one-fourth more two years ago, 110 volt lamps now selling at 18 cents each in barrel lots of 200 to 250, while 220-volt lamps sell at 20 cents in barrel lots.

It is difficult to make a fair comparison between high and low voltage lamps, because of the different conditions under which they are used. Considering the lamp alone, a fair test could be made by burning a number of lamps for 110 and 220 volts at different efficiencies and then finding the life curves which had the same general characteristics. A 110-volt lamp operated at a certain efficiency might then be compared with a 220-volt lamp burned at such an efficiency that its candle power dropped off at about the same rate as the 110-volt lamp. Another basis of comparison would be to note the ratio of annual lamp renewals to total number of lamps installed in various

1. *American Electrician*, Vol. 10, Page 249, June, 1898.

1. See Proceedings Northwestern Electrical Association, 1897, pages 18 to 29 and 47 to 49 also *Elec. World*, XXX: 120; Lond. *Elec. Rev*, XLI: 233, etc.

stations, and then compare the efficiencies of lamps when the ratio for a 110-volt plant is found to be the same as that for a 220-volt plant. The latter would seem to be the more correct method were it not for the fact that most of the 220-volt plants have been installed recently and the circuits are presumably designed for approximately the present actual load, while the stations using 110-volt lamps have usually been in operation for a number of years, and the circuits are likely to be not only overloaded, but also unsymmetrically loaded, so that the range of voltage is much worse, even allowing that the voltage at the main center of distribution is regulated as closely as in the 220-volt plant. In such a test the "personal equation" of the plants is a large factor, the layout of the circuits, distribution of load, regulation of dynamos and the practice in replacing old unbroken lamps affecting the results.

It is, therefore, not surprising that different lamp agents make varying claims in comparing 110 and 220-volt lamps from their own factories. One lamp agent holds that his 4.4-watt 220-volt lamp is the peer of his 3.5-watt 110-volt lamp; another says his 4-watt and 3.5-watt lamps are comparable; another claims his 3.8-watt 220-volt lamp is the equal of his 3.5-watt 110-volt lamp; still another believes that his 4-watt 220-volt lamp is the peer of his 4-watt 110 volt lamp, giving as proof the fact that a station using his 3.6-watt 110-volt lamps buys annually as many lamp renewals as there are lamps installed, while another station using 220-volt lamps buys only one-third that proportion of renewals.

In comparing the performance of incandescent lamps, it is necessary to consider a number of conditions that materially modify the conclusions that might be drawn from accurate tests conducted under laboratory conditions.

In the actual practice of the small (not excluding many of the large) central stations, the variation of voltage is such as to require the use of low-efficiency lamps. It is well understood by engineers, although not sufficiently appreciated by owners and operators, that fluctuations of voltage affect the candle power and life of high-efficiency lamps far more than those of low-efficiency lamps. Owners and operators do not usually realize how rapidly an excessive voltage decreases both the life and the candle-power of incandescent lamps. In the smaller plants especially, the man in charge of the dynamo has so many other duties that he does not keep close watch of the voltmeter, and the voltage is frequently so high as to cause an excessive lamp breakage unless the lamps are of low efficiency. In a surprising number of plants the voltmeter is of poor construction or is even entirely absent, so that the operator governs the pressure entirely by his eye, keeping the lamps "about right." In one case complaint came that the 3.1-watt lamps furnished were of poor quality, and investigation showed that the 110-volt lamps were being operated at 130 volts, so that it was no wonder that some of them lasted only six hours.

Even when the operator appreciates the importance of maintaining the voltage constant, it frequently occurs that the voltmeter is connected to the circuits at the power house, rather than at the main center of distribution, so that while the pressure may remain reasonably constant at the power house, it rises excessively at distant points when the load drops off. One customer of a comparatively large station reported that his voltage varied from 90 to 120 volts at different hours of the day. In the ordinary lighting system the distributing circuits are so laid out that the drop from the main center of distribution to the farther lamps is so great as to cause extreme variations of voltage. This poor design and construction of circuits is due to four reasons: The wretched work of poorly-prepared men who pose as electrical engineers; the limited amount of money available for conductors; the desire to make the least money cover the largest possible territory, and the unsymmetrical overloading of the circuits as business grows. The result of all these conditions is that the voltage varies to such an extent that only a low-efficiency lamp will give satisfaction in the average central station. High-efficiency lamps requiring 3.1 watts per candle are used successfully in plants where the conducting system and the operation of the station are such as to insure close regulation of voltage at the lamps within about 3 per cent.

As was so well brought out in J. W. Howell's classic paper on "The Maximum Efficiency of Incandescent Lamps," before the American Institute of Electrical Engineers in May, 1888,[1] the lamps should be operated at such a voltage and efficiency that the total cost of operation, including fuel, lamp renewals, and all other costs, should be a minimum. The difficulty with the practical application of this simple rule is that some of the elements of cost are easily recognized, while others are not so easily discerned. Without the aid of skilled electrical engineers, it is difficult to analyze accurately the elements of the total cost of electric light. The cost of lamp renewals is an element that is patent on the bills, and the vast majority of plant owners wish to see such items reduced to the minimum, so they continue to demand lamps giving long life. The customers of central stations also desire lamps of long life, to avoid interruption of service by lamp breakage and to reduce the charges for new lamps. Of course, where current is paid for by meter, the station operator does not object if his customers desire long life lamps, since the latter do not appreciate their effect upon the meter bills.

As a result of the above causes, the lamp supply people have learned that for the average station 3.1-watt lamps are not at all satisfactory, 3.5-watt lamps give better results, but the people seem to be pleased still better with lamps requiring about 4-watts per candle. The 220-volt lamp has therefore to compete not with the 3.1-watt lamp, but rather with one requiring 3.5 or 4 watts per candle.

Another item that lessens the relative disadvantage of the 220-volt lamp is the fact that the smallest size wire allowable on pole lines is governed not by minimum allowable conductivity, but rather by minimum allowable mechanical strength. Good practice does not permit any copper wire smaller than No. 10 B. & S. G. to be used on outside construction (this limit not applying to wires in cables or to hard-drawn bare conductors such as are used in telephone work). No. 10 wire is used to a large extent for small mains on 110-volt circuits, and naturally therein occurs a considerable portion of the total drop on the line at times of heavy load. When the pressure is doubled and 220 volt lamps are used instead of 110-volt, the current on the line is nearly halved, and therefore the drop is also halved, while the percentage drop is only one-fourth. For example, suppose on a certain circuit that 110-volt lamps take a current of 10 amperes, entailing a drop of 2.2 volts in the part of the line which consists of No. 10 wire; now, if the pressure be raised and 220-volt lamps be substituted, the current will be approximately 5 amperes, the drop will be then only 1.1 volt. In the first case the drop is 2 per cent. of the lamp voltage, while in the second it is only one-half of 1 per cent. The result is that, assuming equally good regulation of voltage at the main center of distribution, the relative fluctuations in different parts of the system will be much less with 220-volt lamps than with 110-volt lamps. This general conclusion is true, even allowing the efficiency of 220 volts to be considerably less than that of 110-volt lamps, making the current at 220 volts sensibly more than half that at 110 volts.

It has been urged with good reason against the use of 220-volt lamps that their low efficiency requires a larger investment in generators and other station equipment for an equal lighting capacity. This is doubtless true, and should be given full consideration, especially in the case of a municipal or an isolated plant where the user of the lights is also the owner of the plant. In the case of the central station for general supply, however, the financial interests do not lie immediately in the same direction. It is coming to be more and more common practice to sell current by meter rather than to furnish lights on flat rates. It is, therefore, to the interest of the station operator to sell as much current as possible, and the user of the lamps does not discern between the watt consumption of his 220-volt lamps and that of the 110-volt lamps in the neighboring town, except to feel sure that his lights are better. Therefore, both the station owner and the lamp user are satisfied.

A real difficulty with the 220-volt system lies in the increasing use of arc lamps. The enclosed arc lamp for use on 220-volt circuits draws a long arc, and therefore gives a light strongly tinged with violet. The color can be toned down by using opal glass for both inner and outer globes, but these greatly reduce the light, already too small. In many cases it is practicable to use two 110-volt enclosed arc lamps in series. While this practice is the general custom and is successful in many cases, yet it is apt to lead to trouble in the case of small plants whose operators are necessarily men of comparatively little electrical and engineering knowledge, and who have difficulty in understanding the adjustment of arc lamps so that two will work properly in series. This is especially true after one of the lamps has been repaired.

The conclusion is that the 220-volt lamp is a commercial success and is coming into more and more extensive use. The intelligent engineer will recognize, however, that each system has its own field. In some places the 110-volt system is best; in others the 220-volt three-wire system is best; in others nothing is suitable except the alternating-current system with transformers. Under certain conditions the 220-volt two-wire system, or the 440-volt three-wire system may compete successfully, and should be considered with great care before the engineer decides which system to recommend for a particular case.

1. *Elec. World*, XI: 160.

The Institution of Electrical Engineers at Paris.

Engineering says that the joint meeting of the British and American Institutions of Electrical Engineers at the United States Pavilion of the Paris Exhibition formed a very pleasant introduction to the Electrical Congress, which was opened two days later. About 60 of the British members, with their ladies, and 25 representatives of the American Institution, had crossed *viâ* Folkestone and Boulogne on August 15, and their numbers were reinforced at Paris. The meeting had been arranged for 9:30 A. M., of August 16, and President Carl Hering, of the New York Institution, opened the proceedings at 10 o'clock. Professor Perry occupied the chair next to Mr. Hering, and the two secretaries, Mr. Ralph W. Pope and Mr. W. G. McMillan, assisted jointly. In welcoming the members, Mr. Hering expressed the hope that the next re union of the sister Institutions would take place in the United States. Professor Perry followed with a few remarks, delivered in his happy humorous vein, and then Mr. Mascart, honorary member and vice-president of the meeting, thanked the members from Great Britain and the United States, for assembling among their French colleagues

There were no minutes to be read, so that Professor Perry at once called upon Mr. de Ferranti to open a discussion on the "Relative Advantages of Alternate and Continuous Currents for a General Supply of Electricity, especially with regard to Interference with other Interests." The Councils had wisely decided not to have any papers read, and the discussion was started by Mr. de Ferranti in the manner the members expected him to adopt; he dealt with his subject on the broadest basis. It was not the old controversy which he wished to renew, but the question as to what the more general use of alternating currents, which was now urged from so many sides, might lead to in the course of the next fifteen years. Was it possible to go on with continuous currents for light and power supply, or would—apart from other considerations upon which he could not touch on this occasion—the manifold interferences, and especially the electrolytic troubles, force us to give preference to alternating currents? We have cables, and pipes, and rails to protect; we have to insure reliable working of our telegraphic and telephonic services; and all our difficulties will continue to increase. His own experiments were almost confined to alternating currents, but he was quite aware that the alternating systems were responsible for a good deal of trouble, and did not even exclude the possibility of electrolytic corrosion.

Mr. Arnold, of Chicago, broadly sketched out American practice. In New Providence the alternating mains had been replaced by 500 volts direct current supply on the 3-wire system; the same had been done in St. Louis, Mo., and in other cities. There was no doubt, then, that the direct current was holding its own in large cities. In small cities and for outlying districts, the alternating currents would preferably dominate; there was, however, the difficulty of equalizing the loads, a difficulty which storage batteries overcome easily in the case of continuous current distribution. Mr. Arnold is an authority on battery power and regulation, which he strongly advocates for stationary plants, reserving his opinion as to car propulsion by storage batteries. The electric railways, he continued, had felt compelled to raise their pressure to 700 volts, and outlying districts were chiefly supplied with triphase currents at 25 cycles. Probably we should eventually do all railway work with phase current transmission and rotary transformers to generate the continuous currents for the working motors.

Sir William Preece, being a member of both bodies, likened himself to the blank leaf between the New and the Old Testaments. Both systems had their good and their bad points, he thought. Alternating currents certainly caused troublesome interferences with telephones; but we had a remedy, on which we should insist for more reasons than one; that is, to apply always complete metallic loops and to twist the wires. He believed in triphase motors, and also in triphase transmission by underground cables; but capacity would cause quite as much trouble as inductance. One thing we should certainly try to bring about soon—standardization of the frequencies. At Niagara 25 cycles had been introduced; in England 50 periods were common; Deptford used 67; the City of London 100; and in some installations we find 130 periods.

Professor A. E. Kennelly was glad that we were clearing up the mists obscuring the question of alternating and direct current supply. As regards illumination, the direct current was best suited for crowded areas. As we extend our area, however, and have to raise pressures to 500 volts and more, the direct system ceases to be profitable. Thus the use of alternating current distribution and lighting for the far districts was almost general in the United States. As regards traction, the analogue was transmission by phase currents, transformed into continuous currents at the farther end. That was an anomalous and expensive combination which we could perhaps best explain on historical lines, as the direct current motor was first in the field. If we could get over the shortcomings of induction motors, then, he agreed with Mr. Arnold, that he would prefer alternating currents throughout. The electrolytic troubles, he thought, were no longer serious, and the damage affected service pipes and cables more than mains. One point could not be disregarded, that is, the increased danger to life which alternating currents bring with them. Our magnetic observatories would have to be transferred to desert regions if we could not sufficiently protect them.

This view was probably shared by the majority of the electricians present; at any rate, nobody raised a serious protest. One speaker afterwards referred to the absurdity of subordinating the claims for an electric railway to the protests of professors at a scientific institute. The fact is that the modern city, with its traffic and manufactories, its smoke and masses of iron, has long ceased to be a suitable quarter for observatories.

Professor Ayrton approached these problems from two sides. Could we do away with the causes of interference, or could we defend our observatories? Concerning the telegraphic service, not many words need be wasted; it was too poor, anyhow. As regards traction, the Board of Trade limited the admissible potential difference between the return and the insulated rails to 7 volts. That rule did not afford sufficient protection, not even as regards electrolytic corrosion. But the general adoption of alternating currents would not altogether help us over the electrolytic difficulty. It could easily be shown by experiment that an ordinary sulphuric acid voltameter, with a platinum electrode in each tube, would generate hydrogen and oxygen in their correct ratio of 2 : 1, whether fed with continuous or alternating currents. And he had two lead pipes on the table demonstrating that such electrolytic corrosion was not caused by fancy laboratory currents only. The pipes came from Deptford; they had been buried 6 in. apart and exposed to alternating currents of 100 volts, whose strength was, by keeping the ground watered, maintained at 1 ampere. They were badly corroded, especially on the sides facing one another. Many complaints of the same evil had been heard in Geneva where the alternating current rules supreme. The tramway companies were quite willing to do their best for the protection of the magnetic observatories, and they had appealed to the Board of Trade for advice. On behalf of a committee, on which Professors Perry and Rücker had also served among others, he could now state that it was quite possible to guard observatories from the evil effects of tramway currents. He would not allow the line to approach the observatory within less than 2 miles, and would divide that portion of the line into sections of 1 mile lengths; the trolleys were to be fed at the middle of each section, with return feeder, also starting from the middle. In that case the potential difference between the return and the insulated rails need not amount to more than one fifth of a volt, which could not disturb magnetic observatories.

Mr. Korda, of Paris, spoke on the use of alternating current motors. Though their regulation was difficult, triphase motors had answered in large sugar works, in spite of special troubles. High voltages were objected to at these works, and more than 200 volts were not applied in practice. The naked cables, which were stretched close to one another, had hence to carry currents of large intensities; the nearness reduced the induction, but the dirt was troublesome. Special exciters were not liked; for if we must have continuous currents for excitation, we might be altogether contented with direct currents. Further, comparatively large engines were wanted for starting; yet these installations were popular.

Professor Crocker, of New York, did not regard the interference question as the essential one; but the discussion had to confine itself to that question. We had to distinguish between induction and leakage effects. Induction produced a magnetic field; but there were only a few magnetic observatories, and that point was not serious; alternating currents gave no permanent field, but they affected the telegraphic service badly. We could avoid that defect, as Sir William Preece had stated; yet in this respect alternating currents were the worst sinners, whilst as to electrolysis the direct currents were more objectionable. He had, however, tested all the New York light mains, and ascertained that the leakage did not exceed 1 per cent. Hence as to interference, the balance between the two systems was doubtful. As regards efficiency of motors, he had also tested a large number of motors of the same capacity, and he found, on the whole, little to say for or against either system, at half loads and greater loads. For light loads, alternating current motors seemed more efficient. With regard

to regulation at constant speed, he had again no preference either way; for regulation at variable speed, and thus for traction motors, the direct current motor was certainly the better, however.

Mr. Mordey returned to the line of argument taken up by Professor Ayrton. Testing 28 miles of tramways, he had never found that the drop exceeded 5 volts, thus remaining under the 7 volts limit of the Board of Trade. It was true that the instruments at the tramway stations frequently indicated higher volts; but that was the fault of the instruments under momentary disturbances. Double insulated returns were good for either system, in many respects. A double line had been used at Cincinnati; he would like to know with what results. The future would probably belong to the alternating current, which its simplicity would force upon us. The rotary converter could not be regarded as more than a makeshift. If all the money spent by the Central London Railway on rotary and static transformers has been expended in conductors, everything would have proved much simpler. The capacity troubles of alternating distribution were, in his opinion, overrated; a visit to St. Petersburg had confirmed him in this opinion.

Professor S. P. Thompson, who, like his predecessor, was asked to condense his remarks owing to the lateness of the hour, was rather astonished that nobody should have referred to ships which started with Siemens alternating plants, and had unfortunately abandoned them again for the worst type of continuous current machines, the bipolar type. Alternating current switches were expensive; that was one objection against them. If arc lamps burned, perhaps, better on alternating circuits, the same could certainly not be said about glow lamps, only we made the mistake of raising the voltage higher and higher, instead of reducing the pressure to 50 or even 20 volts; only in the latter case could we keep to the three watts per candle, which were generally claimed without justification for 110-volt lamps. Two statements he opposed directly; the alternating currents were not more dangerous than direct currents, and the high starting current, supposed to be required by triphase motors, looked very much like one of the old fallacies which everybody believed, until somebody thoroughly investigated the matter. Professor Carus Wilson's quite recent experiments as to acceleration and starting torque were by no means unfavorable to triphase motors. As to electrolysis by alternating currents, that depended largely upon the electrode area, current density, and reversibility, of the polarisation effect; this question is, of course, not new. Some people talked of the new Central Electric Railway in London as a trial of the triphase current, but nothing more was done in reality than had been tried at Gross Lichterfelde, near Berlin, 15 years ago. We might speak of a success, but we could not obtain any information from the new undertaking.

Mr. Ward Leonard took the opposite side again. He had not been favorably impressed by the slowly starting phase motors he had seen in Switzerland, and he remained an advocate of continuous current motors. His advice was to put transformers and continuous current motors on the vehicle to be propelled.

The Presidents refrained from summing up, and the discussion was thus brought to an informal conclusion. Four gentlemen, members of the respective juries, then gave the audience, so far as time allowed, some excellent hints as to features of special interest in the Exhibition. These gentlemen—Mr. Hospitalier, who dealt with dynamos; General Webber, who reviewed the measuring instruments; Mr. Gavey, who spoke on telegraphs and telephones; and President Hering, who advised as to electro chemistry, conducted parties in the afternoon.

On Friday morning a visit was paid to the transforming station of the Westinghouse Company, opposite the striking dome of Messrs. Schneider. Both the moving platform and the electric railway of the Exhibition are driven from this station, it will be remembered. The plant has been devised by Mr. Albert Schmid, Director of the Paris Westinghouse Company, the Société Industrielle d'Electricité, Procédés Westinghouse, and installed by Mr. M. Coster, their Manager. The latter and his able assistants, Messrs. L. A. Phillips, Wolfe, W. D. Brown and C. Koppits, put the huge machines through a very interesting, though somewhat daring, cycle of performances, starting both lines, and running them from various motors, etc. The transformation is effected in two ways. First, by means of a triphase motor of 5,000 volts and 850-horse power, driving a continuous current generator; secondly, by a converter which receives current at 360 volts from six static transformers, and yields direct current of 550 volts. The whole installation is double. To watch these gentlemen, moving the switches apparently without consulting one another, was a striking demonstration of their mastery over their machines.

In the afternoon members, by invitation of the Chemin de Fer de l'Ouest, paid a visit to the new electric power station at Moulineaux, which will run the Paris-Versailles electric line and the electric railways from the Champ de Mars, and which is supplying primary current to the Westinghouse station just mentioned. The visitors were conducted by Mr. Clérault, the Chief Engineer, to whom the project is mainly due, and by the Engineers, Mr. Mazen and Mr. Brant. The programme included visits to Moulineaux, to its testing house (maison de vérification), the transformer stations at the Champ de Mars and the Invalides, the locomotive sheds and pneumatic power stations, were as stupendous as the works are; and if the working is conducted with the skill, completeness and punctuality with which this most instructive programme was carried out on a very hot afternoon, the railway company will have some return for the very large sums they have invested in this enterprise, which is to reform the traffic in the western suburbs of Paris. We shall deal with this plant, which is of peculiar character, in a future issue.

How to Use Water in Steam Pipes.

At a conference of English electrical engineers held recently at Huddersfield, the utilization of water in steam pipes received much attention. They visited a number of plants where there were installed plants for the purpose of using this waste water. The greatly increasing demand for steam and steam appliances has brought forward the question of economy and improvements in this direction and has recently demanded and received a large amount of attention from engineers. As the result of careful investigations and experiments in this line, an apparatus has recently been placed upon the market which discharges some most important and hitherto unknown functions, based upon two simple laws of nature, namely, the force of gravity and the tendency of gases to flow to the the point of the lowest pressure. The apparatus has been thoroughly tested for some two years, and, it is claimed, with good results.

Every engineer is aware of the inconveniences, the delays and dangers, that arise from the presence of water in steam pipes, which in many cases has resulted in loss of life, cracked cylinders and lids, straining and pounding of engines, and so forth. Again, it is also important that in remedying this evil, the water in the steam pipes, with all its valuable store of heat, should go back into the boilers, so that these should not only be able to use it over again, but also the embodied heat, which is practically boiler temperature, requiring but a very few units of additional heat to convert the water into steam again. This apparatus is said to accomplish this. Moreover, it draws away all water before reaching the engines, thereby only allowing dry steam to pass into the cylinders, while feeding the boilers with water at a high temperature. Other important points are the advantages derived from feeding boilers as near boiler temperature as possible, which consists in a direct saving of coal, this tending to prolong the life of the boiler and to obviate the danger of leakage; while by feeding the boiler with the water of condensation, which is pure, the evaporation capacity is greatly increased, as this water prevents scaling on the boiler plates. The apparatus performs these duties without the aid of any moving parts, and it is therefore almost impossible that it should get out of order.

In this invention there is a receiver which is placed below the lowest point to be drained. This receiver acts as a storage for undue amounts of water, so that the riser pipe, which draws through a special outlet, may not get water bound, but may act at a constant rate, independent of periodical discharges, into the receiver. All flow of condensation into this receiver is through a suction tee. A pipe is tapped into the forcing end of this tee and drains one of more separators or bottles at convenient distances from the live steam main. Its object is two fold; it not only serves to maintain the receiver pressure, as near as possible to the boiler, by making good any undue drop in pressure from the secondary sources, but also helps to draw the drainage, on the ejector principle, from the drip receiver which receives the drip from all secondary sources.

From the receiver the water is swept up the riser pipe in sections or finely divided particles, into a separator. The purpose of this separator is merely to start the water easily and rapidly down the return pipe which feeds one or more boilers. The necessary drop in pressure in the separator, to guarantee the circulation up the riser pipe, is producing by a small pipe which is regulated by a reducing valve. If there is no convenient method of utilizing this small quantity of steam through the valve, a pipe is connected to the feed pump discharge, allowing a small quantity of cold water to be injected into the top of the separator, making a slight vacuum, and producing the same circu-

lation up the small pipe. The column of water in the return pipe, plus pressure, overcomes the boiler pressure, and so produces a continuous return. It should be noted that it is immaterial whether the points to be drained are below or above the boiler water level.

American Coal for Foreign Consumption.[1]

According to Mr. C. J. Wittenberg, president of the Chesapeake & Ohio Coal and Coke Company, who recently returned to this country from abroad, there is an excellent opportunity, if only taken advantage of, for dealers in this country to gain a prominent foothold in the coal markets of the various countries on the continent of Europe. As was stated some time ago in these columns, many of the electric lighting and manufacturing plants, more especially in Russia and Germany, were a few months ago almost destitute of fuel, owing to the inability of obtaining sufficient coal from Great Britain, with the result that many factory and other kindred industry owners are said to be looking into the feasibility of obtaining fuel from the United States.

The gentleman quoted above referring to this subject says:

"In 1899, England's shipments of coal to countries which we can reach exceeded 30,000,000 tons. Up to 10 years ago she had about all the West Indian and South American coal trade, most of which we have taken from her. We can now get our share of the world's trade, if we can get the ships. But the coal men of the country need to be aroused on the matter.

"While I was abroad I noticed a remarkable inquiry for American coal. The number of the people who called upon me in Paris to obtain data on the subject was astonishing. And in Denmark there was a special interest in the matter taken by the big gas concerns. The American coal exhibits at the Paris Exposition are attracting a great deal of interest, but they are so poorly accommodated, in out of the way quarters, that they are not shown to best advantage.

"Inquiries are being made for American coal by both the French and the Italian Governments for their respective navies. About July 1 there was a bill introduced in the British Parliament to prohibit the exportation of smokeless coal from Great Britain. It was argued that smokeless coal was like smokeless powder, and should be regarded as too precious to sell to other nations. No decisive action has been taken on this bill, but the French Government, in alarm, at once placed large orders for smokeless coal in England. Still fearing that it may never be able to have them filled, it is now on the lookout to get its coal from America, if need be.

"The principal points to which it would now be advantageous to us to ship coal would be on the Mediterranean, of course, because the low freight rates from England to other European centers make it hard for us to compete with Great Britain. As far as quality goes, the best American coal can about equal the coal from Cardiff, Wales, which is the best in Great Britain. Our coal is not so lumpy as the Cardiff coal, but that is really nothing in favor of the British product, though there is a prejudice for lumpiness in Europe. The British coal costs $7.50 at Cardiff, and can be delivered at $10 a ton on the Mediterranean. Ours costs $2.50 at Newport News, and can be delivered at about $7.60 on the Mediterranean. But we are sending very little thither, because we cannot get the ships."

After stating that most of the interests in England owning coal-carrying vessels are also interested in the British mines, Mr. Wittenberg adds that "if we could only have a subsidy measure passed which would encourage the building of American ships we could quickly build up a coal carrying trade. We could build fully as good ships as they have abroad. I think even with the vessels diverted to transport service back at our disposal that coal freights to the Mediterranean would come down from $5 to $4 or $3.50 a ton, and enable us to undersell the British in Italy from $3 50 to $4 a ton."

In this connection it is interesting to note that the aggregate exports of coal from the United Kingdom for the six months ending June 30, this year, were 22,063,206 tons as compared with 20,990,630 tons in the corresponding period of 1899. Of this amount 4,230,783 tons went to France, 2,704,757 tons to Germany, 2,625.913 tons to Italy, the remainder being distributed between Russia, Sweden, Norway, Denmark, Holland, Spain, Portugal and other minor countries.

These figures will give our coal dealers some idea of the strong hold England has on the coal markets of the world, but in spite of this fact if sufficient interest is aroused, there would seem ts be no valid reason why American coal should not ultimately be burned to run lighting, street railway and manufacturing plants in many European countries.

1. *Electricity.*

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. J. N. GOLTRA, Secretary and Treasurer of the Soo Light and Power Company of Sault Ste Marie, Mich., writing to the JOURNAL under date of the first inst., says: "We are a new member of the lighting family, just organized under a 30 year franchise for gas, and also one for the same term for electric light and power. We would be glad to have you put our name on your subscription list * * * and to also announce that we are calling for bids for construction of gas works and electric light plant. Sault Ste Marie is such a rapidly growing city that its population, as shown by the recent census, exceeds by 2,000 any estimate made before it was taken. We do not remember to have noticed this of any other city. The enormous development of water power, and various industries dependent upon this and now nearing completion, cannot fail to even double the present population, which is 12,000."

MR. HARVEY CRAWFORD, who served the Cedar Rapids (Iowa) Gas Company as cashier for quite a period, has accepted the post of cashier to the Waukegan (Ills.) Gas Light Company.

MR. ROBERT S. RAY has been appointed manager of the Windsor (Can.) Gas Company, vice Mr. W. D. West, who, as was formerly noted in the JOURNAL, is to take charge of the Marion (Ohio) Company's plant.

THE Western Gas Construction Company of Fort Wayne, Ind., is under contract to erect a complete system of coal gas apparatus for the proprietors of the Waukegan (Ills.) Gas Light Company.

MR. W. A. ALDRICH, Secretary of the Spokane Falls (Wash.) Gas Light Company, writing under date of August 27th, says:

To the Editors AMERICAN GAS LIGHT JOURNAL: In the discussion[1] following the reading of the paper by Mr. John A. Britton before the Pacific Coast Gas Association, I am quoted as saying, "Gas stove advertising is no good." This should have been, "Newspaper advertising is no good." I am glad to see that the New York companies have adopted the system of renting gas stoves, and I hope to see the plan followed by all the gas companies, as it will surely pay them handsomely on the investment.

BY way of comment on the correction forwarded by Mr. Aldrich, we might remark that right before us is a copy of the Trenton (N. J.) *Times*, of date of August 18th, in which issue appear four solid pages devoted to a recital of what Mr. Frank D. Moses and his associates of the Trenton (N. J.) Gas and Electric Company have done in the way of placing gas stoves in the Capital City of New Jersey since they took hold of its gas properties. The main portion of the advertisement is devoted to a presentation of the names together with the residences of those using gas stoves, and the balance is given over to a well arranged illustrated list of the stoves and other gas appliances which the Company handles. There are over 1,600 gas stoves and ranges connected up in Trenton.

MR. J. D. TAYLOR, JR., formerly Agent of Branch No. 2 Hudson County (N. J.) Gas Company, which position he was obliged to resign last March because of ill health, writes us from Denver, Col., under date of August 30th, that he has made so satisfactory a recovery that he has accepted a position with the Denver Gas and Electric Company in its appliance department.

THE Hudson River (N. J.) Gas and Electric Company has been awarded the contract for the public lighting of Hastings-on-Hudson for the ensuing year.

DEEDS transferring a plot of land at the corner of A street and 10th, Tacoma, Wash., have been recorded. The new owner is the Tacoma Gas and Electric Light Company, whose proprietors propose to erect a handsome office structure on the corner named.

A CORRESPONDENT in Augusta, Ga., forwards the following: "Augustans who use gas for illuminating purposes will be treated to a raise in price of that article, on and after September 1st. The reasons assigned for this increase are set forth in a circular issued by the Gas Light Company, under date of August 25th. The circular reads:

"'To Our Patrons: On and after September 1st the gross price of illuminating gas will be $1.75 per 1,000 feet, with a discount of 25 cents per 1,000 feet, if paid for before the 10th of the month, making a net price of $1.50 per 1,000 feet. The gross price of fuel gas will be $1.35

1. Ante page 388.

per 1,000 feet, with a discount of 25 cents per 1,000 feet, if bills are by the 10th of the month, leaving the price of fuel gas the same as formerly, THE GAS LIGHT COMPANY OF AUGUSTA, by D. B. DYER, President.'

"The following statement was appended to the circular: 'My associates owning the Gas Company have been disappointed in its condition and the results of their investment, and since acquiring the property have been called on to put out large sums of money in repairs, relaying and extending the mains, and otherwise improving the plant, in order to supply the best of service. It was supposed that the reduction made in the price of gas would so largely increase its consumption that money could be made at the extremely low prices; but after 15 months' trial it has been demonstrated that the receipts are not sufficient to support the plant. Besides, the largely increased price of coal and supplies has materially increased the cost of producing the gas, while it has been sold at reduced prices. The net price we ask is not in excess of Birmingham and Chattanooga; although those cities are in the heart of the coal fields, where coal is about $2 per ton cheaper than at Augusta; nor is illuminating gas higher here than at Savannah, Macon or Columbus, and is lower than at Charleston. We sell fuel gas cheaper than any city in the State except Atlanta, which is the only city in the State where illuminating gas is cheaper; but Atlanta uses more than all the cities of the State combined. And as the receipts have failed to pay interest on the investment the necessity of restoring the price must be obvious. Although the Company has since the large reduction constantly lost money, the work of bringing the plant to a complete state has steadily gone forward and first-class service is now being given. My associates and myself, who own the Augusta Railway and Electric Company, feel that we have passed through the experimental stage, and the improvement from now on will be constant, and I cordially invite the citizens of Augusta, who may feel so inclined to take stock in that enterprise; and when the Company is put upon a profitable basis I hope to make the same offer relating to that stock. Realizing that some will be skeptical of any statement, however earnest and truthful, I wish to state that cheerful access to our books will be given to any customer who desires to make inspection. Yours very respectfully. D. B. Dyer.'"

THE City Council of Council Bluffs, Iowa, has granted a franchise to the projectors of the Bluff City Electric Light and Gas Company for the erection and operation of electric and gas lighting, power and heating plants, and for the maintenance and operation of such plants. The ordinance grants a franchise subject to the approval of the voters of the city at a special election to be held October 2, 1900, for a term of 25 years, and provides that the electric lighting plant is to be in operation within 10 months, and the gas plant within 15 months. It is provided that arc lighting, either public or private, shall be done at a rate of not more than $69.50 per light per year, under the Philadelphia moontable, that electricity for incandescent lighting shall be sold at a rate of 15 cents per 1,000 watt hours and for power purposes at a rate of 10 cents per 1,000 watt hours, and that gas shall be sold at a rate of not more than $1.45 per 1,000 cubic feet. Thomas Bowen is reported to be at the head of the concern, and his attorney is John P. Organ.

THE bondsmen on the $50,000 bond submitted on behalf of the Federal Gas and Fuel Company of Columbus, Ohio, are: Messrs. H. C. Ellison, Vice President State National Bank, Cleveland, Ohio; D. H. Kimberly, President Central National Bank, Cleveland, Ohio; Charles O. Everett, President Produce Exchange Bank, Columbus, and C. L. Kurtz and E. M. Poston of Columbus.

THE new mortgage issue on the properties of the Waynesboro (Pa.) Gas Light Company has been placed. It amounted to $20,000, and the bonds bear interest at the rate of 5 per cent. per annum.

MR. JOHN A. BRITTON, the active business representative of the Oakland (Cal.) Gas, Light and Heat Company for many years, and the President of the Pacific Coast Gas Association, has been elected President of the Oakland Company. Shortly after his election a reporter of the Oakland *Enquirer* had a conversation with Mr. Britton regarding his views as to how a gas company should be conducted, and this is the result of the interview: "The policy of our Company has been formulated on the principle that in dealing with the people, from whom it derives its power to exist, a fair treatment of the public is the only requisite to success. Following are its general plans: At no time in its history has the Company earned or attempted to earn interest on capitalization in excess of the actual amount invested in its plant. The dividends declared by the Company have averaged less than 3 per cent. on the capital stock, and never exceeded 6 per cent. on actual cash value of plant. It has believed in making the public profit-sharers by reduction of rates, instead of maintaining high rates for the benefit solely of its stockholders, and the people might in this regard be considered as owners of common stock in the corporation—so that all actions by the Company are indirectly shared in by the public. It has met every reasonable demand for extension of its services, both gas and electricity, thus helping to build up new territory. The consumer has always received the benefit of the doubt when a contention arose. The service has always been of the best, the quality increasing in efficiency by the adoption from time to time of new methods in manufacture of gas and generation of electricity, and no attempt has been made when cheapening price to depreciate quality. No employee of the Company will be retained in its service who does not at all times and under all conditions give respectful heed to all complaints from consumers. It has believed the growth of the city to be a benefit to its business and encouraged in every way new enterprises by devotion of time and money, trusting to the future for compensation. It has realized that it should bear its burden of taxation for municipal, County and State purposes and has never evaded payment of the same. It has conceded to the authorities the right to govern it in the use of its franchise and in its exercise has not destroyed property, but assisted the authorities in the protection of same. In brief, it believes that the public has rights which it, as a corporation, is bound to respect, and before entering upon any matter has taken the trouble to ascertain fully the extent of such rights, and has invariably respected them. All of the consumers have equal rights, and in the office or at the house, each person, whether a large or small consumer, is treated with equal consideration. It has practiced conciliation and deprecated antagonisms. It believes that small profits and a satisfied people are better than large profits and dissatisfied ones. All complaints, however trivial, receive full and complete attention and no consumer is permitted to go away dissatisfied. It has tried to do right and be square with everyone; to value the honor of its corporate name, and to guard it with the same jealousy that a man guards his own personal reputation and honor."

IT is reported that the properties of the Youngstown (Ohio) Gas and Electric Light Company have been purchased by New York capitalists, the new owners to assume possession October first.

MR. T. W. SUMMERS has been appointed General Superintendent of the many gas properties controlled and operated by Mr. W. T. Morris, of Penn Yan, N. Y., and his associates.

HEREAFTER no charge will be made by the Consolidated Gas Company of Baltimore, Md., for connecting gas stoves to its mains. The President of the Company (Gen. Ferdinand C. Latrobe) also favors abolishing all charges for connecting the services of consumers to the Company's mains, irrespective of the purpose for which the gas is to be used.

THE Marion Gas Company, as the successor of the Marion (Ohio) Gas Light Company, was recently incorporated by Messrs. H. J. Lesher, James T. Lynn, M. B. Daly, J. P. Degnan and Julian H. Tyler. The capital stock was fixed at $150,000.

FORMAL notice has been served on the Aberdeen (South Dakota) Gas and Electric Light Company that proceedings to forfeit its charter will be commenced within the prescribed statutory time for its failure to light the city under the terms of the franchise.

THE New Jersey Gas, Electric and Traction Company has issued a blanket mortgage of $6,000,000, which has for its underlying value the properties of the following concerns: The Camden Gas Light Company, the Camden Gas and Fuel Company, the Camden and Burlington Gas and Electric Company, the East Side Gas Company, the Gloucester Electric Light Company, the Consumers' Gas Company, of Woodbury, the Woodbury Electric Light and Power Company and the Camden, Gloucester and Woodbury Railway Company.

Engineering News says that a large water power enterprise is under way at Hamilton, Ont. A canal is to be run from Lake Erie to Hamilton, and construction has begun at Silverdale, Ont., on the line of the canal. The source of the water supply is the Welland River, a stream which flows into the Niagara river. The canal will run to Jordan river, a stream which enters Lake Ontario. The total fall which can be utilized for power is about 250 feet. A contract to deliver 15,000 electric horse power has been made with the Canadian Steel Co., located at Welland, which is expected to be in operation at about the same time as the power plant, in September, 1901. The canal is to be 150 feet wide at the top, 60 feet at the bottom, and 12 feet deep, with a current of 3½ miles per hour. The initial plant is to develop 25,000-horse power, which can be increased to 50,000 or 60,000, as required.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

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AGENTS:
New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, SEPTEMBER 10, 1900.

The Market for Gas Securities.

Dullness ruled in the city gas share market during the week, although the business for actual transfers was in greater volume than for perhaps a month. Values were fairly well maintained, the shading being on the low side. Consolidated opened to-day (Friday) at 172½ to 173, and the closing was made at 171½ to 172, ex-dividend. Holders of Consolidated may lay to themselves the ointment that all sores, because of lapses in the dividend rate during 1899 are to be salved by a goodly extra return shortly before the end of the year. Mutual, held outside of the controlling clique, is in good demand. The joke of the local market is the price at which Brooklyn Union gas is offered. Nominally, the rate is 172. An order for 500 shares for transfer wouldsend it to 200, at which price it would be cheap.

The outside market is "spotty," with Peoples, of Chicago, at the remarkably soft price of 90¾. The competition game there is so small that no one should be fooled by it. Peoples is worth par and more, and it will be at 110 before Christmas. Baltimore goes on to a price nearer its fair level, and the general market reflects the confidence of investors, especially in respect of fair gas bond issues.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

SEPT. 10.

☞ All communications will receive particular attention. ☜ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated—Ex rights	$4,595,200	100	171	172
Central Union, Bonds, 5's.	3,000,000	1,000	106	107½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,350,000	1,000	120	..
Metropolitan Bonds	658,000	..	108	112
Mutual	2,500,000	100	305	320
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	105¾	106½
Northern Union, Bonds, 5's.	1,250,000	1,000	102	103
New York and East River ..				
Bonds 1st 5's	3,500,000	1,000	105	106⅝
" 1st Con. 5's	1,500,000	..	115	..
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	121	125
Preferred	5,000,000	100	141	145
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	114
Yonkers	299,680	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	164	172
" " Bonds (5's)	15 000,000	1,000	116	119
Bay State	50,000,000	50	1	1½
" Income Bonds	2,000,000	1,000		75
Binghamton Gas Works	450,000	100	23½	30
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4	5¼
" " Bonds, 5's	5,250,000	1,000	64	67
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati G. & C. Co.	8,500,000	100	199½	201
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,036,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	105
Consumers, Toronto	1,700,000	50	230	235
Consolidated, Baltimore	11,000,000	100	57½	58
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	12½	15
" Con. Mtg. 5's	380,000	1,000	82	86
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95	97
" Prior Lien 5's	4,598,000	1,000	99½	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	230
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	70	80
" Bonds, 6's	2 650,000	..	98	100
Jackson Gas Co	350,000	50	70	75
" 1st Mtg. 5's	250,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	101½	103
Laclede, St. Louis	7,500,000	100	75	75½
Preferred	2,500,000	100	98	100
Bonds	10,000,000	1,000	110	110½
Lafayette Gas Co., Ind.	1,000,000	100	35	40
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co.	400,000	100	70	75
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	183	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,500,000	..	..	103
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	90¾	90⅝
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅝	111¾x
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47¼	47½
St. Paul Gas Light Co.	1,500,000	100	49½	53
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	88	90½
St. Joseph Gas Co.	1,000,000	100	30	34
" 1st Mtg. 5's	750,000	1,000	96¼	98
Syracuse, N. Y.	1,750,000	100		15
Bonds	1,612 000	1,000	88½	93
Washington, D. C	2,000,000	20	270	271
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	95	98
Bonds, 5's	3,880,500	..	104	108
Wilmington, Del.	600,000	50	200	210

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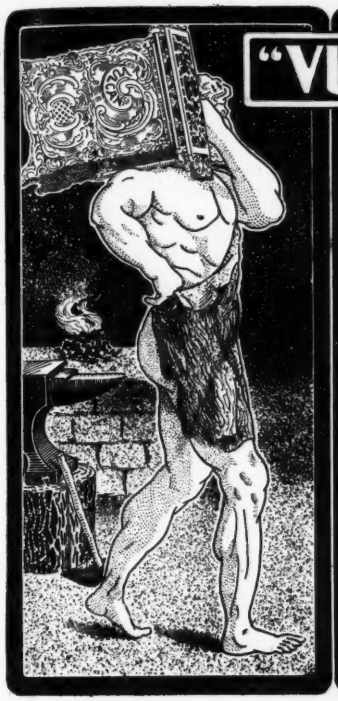

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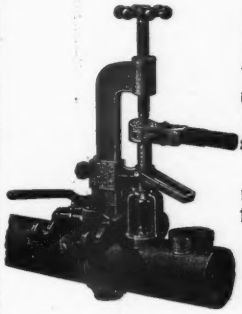

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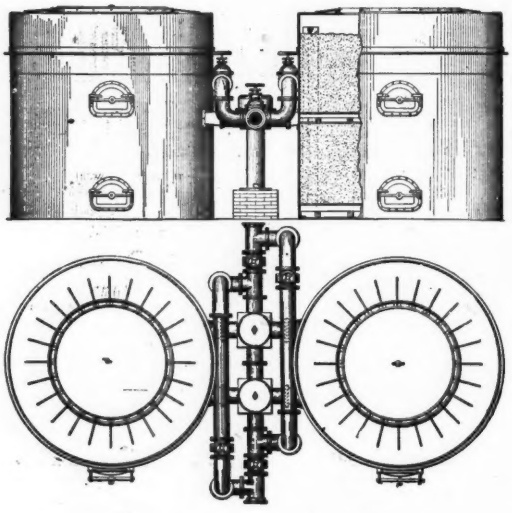

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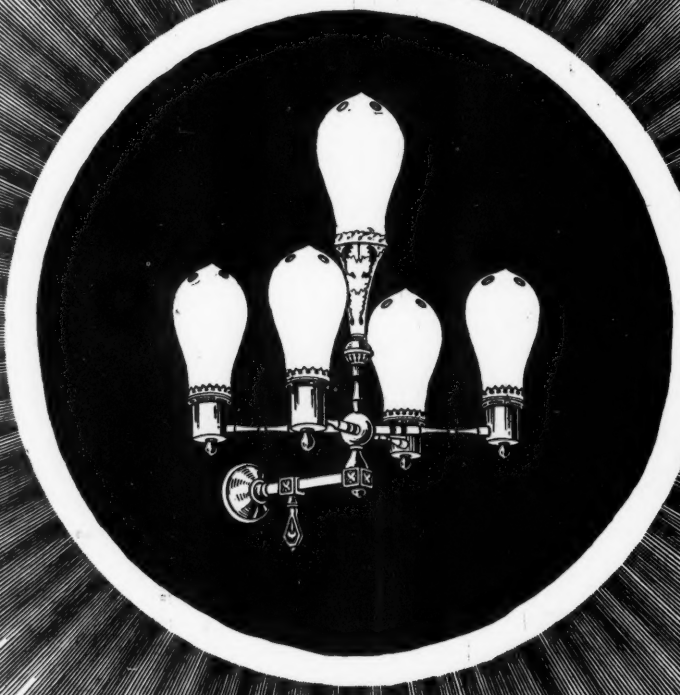

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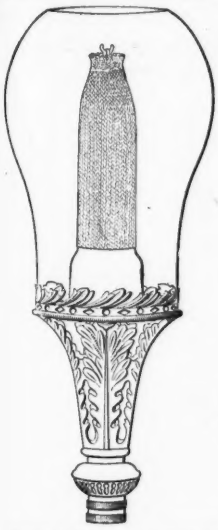

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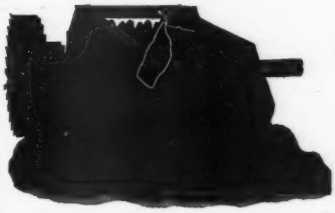

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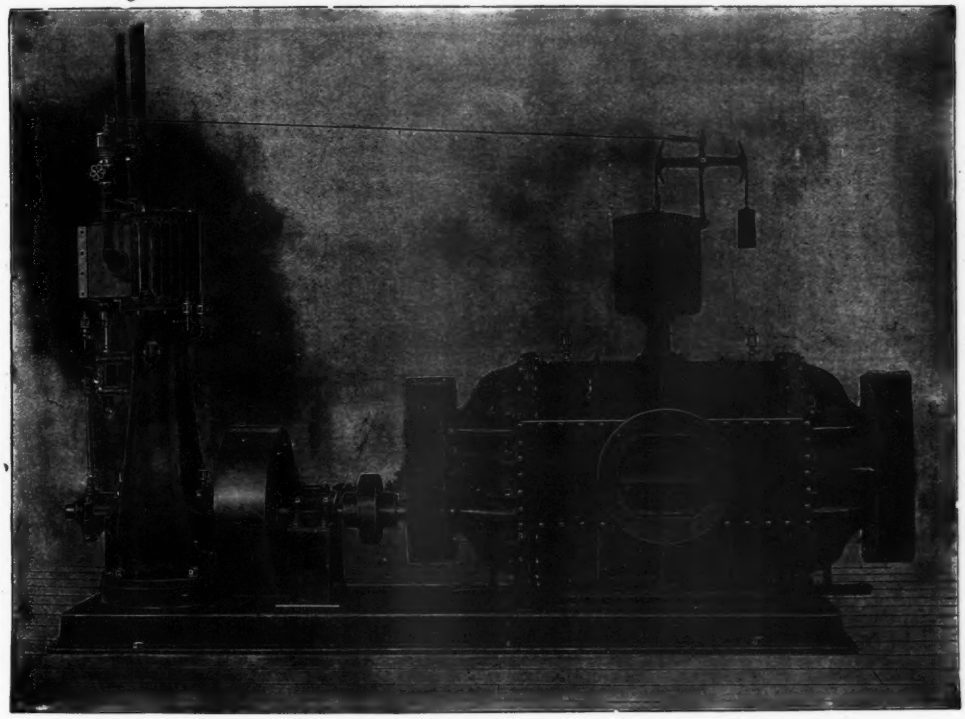

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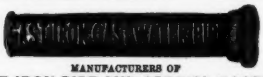

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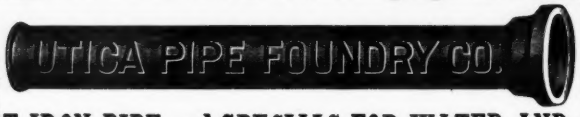

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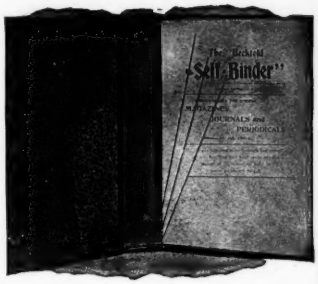

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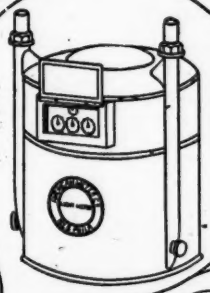
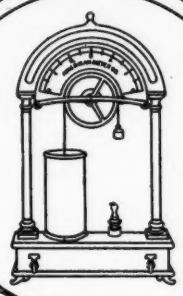
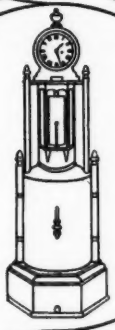
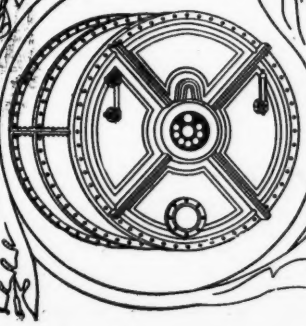




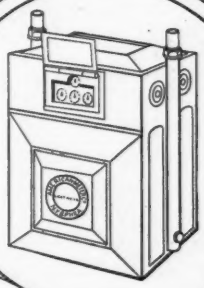


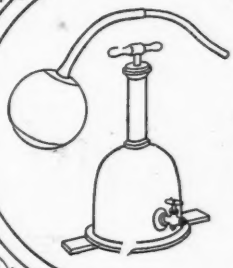


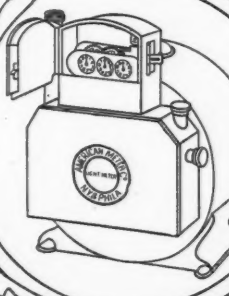
PUBLIC LIGHTING TABLE.

SEPTEMBER, 1900.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	9.20 PM FQ	4.20 AM	6.30	4.20
Sun.	2	10.10	4.30	6.30	4.20
Mon.	3	11.10	4.30	6.15	4.30
Tue.	4	12.10 AM	4.30	6.15	4.30
Wed.	5	1.20	4.30	6.15	4.30
Thu.	6	2.30	4.30	6.15	4.30
Fri.	7	No L.	No L.	6.15	4.30
Sat.	8	No L. FM	No L.	6.15	4.30
Sun.	9	No L.	No L.	6.15	4.30
Mon.	10	6.40 PM	7.50 PM	6.05	4.40
Tue.	11	6.40	8.30	6.05	4.40
Wed.	12	6.40	9.10	6.05	4.40
Thu.	13	6.40	10.00	6.05	4.40
Fri.	14	6.40	10.50	6.05	4.40
Sat.	15	6.40 LQ	11.50	6.05	4.40
Sun.	16	6.30	12.50 AM	6.05	4.40
Mon.	17	6.30	1.50	5.55	4.50
Tue.	18	6.30	2.50	5.55	4.50
Wed.	19	6.30	3.40	5.55	4.50
Thu.	20	6.30	4.50	5.55	4.50
Fri.	21	6.30	4.50	5.55	4.50
Sat.	22	6.30	4.50	5.55	4.50
Sun.	23	6.20 NM	4.50	5.55	4.50
Mon.	24	6.20	4.50	5.40	5.00
Tue.	25	6.20	4.50	5.40	5.00
Wed.	26	6.20	4.50	5.40	5.00
Thu.	27	6.20	4.50	5.40	5.00
Fri.	28	7.20	4.50	5.40	5.00
Sat.	29	8.00	4.50	5.40	5.00
Sun.	30	9.00	5.00	5.40	5.00







TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45

NEW YORK, 33 Nassau St. PHILADELPHIA, Broad and Arch Sts. CHICAGO, 54 Lake St.

Welsbach Street Lighting Company

.... OF AMERICA ....

No. 26.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in seventy-five Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

No. 38.

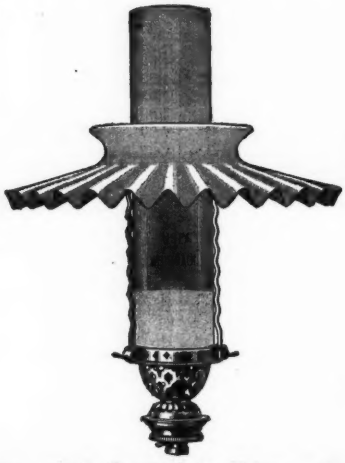
Correspondence solicited from Gas Companies and others interested in Municipal and outside lighting.

Welsbach Famous Mantles.

THE INCOMPARABLE

YUSEA Welsbach MANTLE

FINEST EXAMPLE OF INCANDESCENT GAS LIGHT EVER EXHIBITED.



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THE HIGHEST ILLUMINATION, The Lowest Cost.

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Chicago Branch Department and Supply House, - - - - - 70 Wabash Avenue.

THE UNITED GAS IMPROVEMENT COMPANY.

THE STANDARD DOUBLE SUPERHEATER LOWE WATER GAS APPARATUS.

CONTRACTS RECEIVED SINCE JANUARY 1, 1900.

	SETS.		SETS.
DANSVILLE, N. Y.	1	CARBONDALE, PA.	1
WEST CHESTER, PA.	1	HACKENSACK, N. J.	1
COHOES, N. Y.	2	TIFFIN, O.	1
OGDEN GAS CO., CHICAGO	1	MOUNT HOLLY, N. J.	1
CENTRAL UNION GAS CO., NEW YORK	1	SEATTLE, WASH.	1
SPENCER, MASS.	1	TARRYTOWN, N. Y.	1
SAN FRANCISCO	1	HOBOKEN, N. J.	2
BROOKLYN UNION GAS CO., BROOKLYN	1	PATERSON, N. J.	2
RICHMOND, VA.	2	NEWARK, N. J.	2
CAMBRIDGE, MASS.	2	JERSEY CITY, N. J.	1

NUMBER OF SETS 26
TOTAL SETS INSTALLED TO JANUARY 1, 1900 327

TOTAL SETS INSTALLED TO DATE 353
TOTAL DAILY CAPACITY . . . . . 226,600,000 Cubic Feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
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H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
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Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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Estimates Furnished on Application for Most Successful Style of Construction.

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Works, Weber, N. J.
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Modern Recuperative Furnaces

And Standard Fire Brick and Gas Retorts.

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Fire Clay Goods for Gas Works.

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HENRY MAURER & SON,

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BENCH SETTINGS,

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GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

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In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

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Containing 6, 8 or 9 Retorts.

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Gas Engineers
INSPECTION AND ADVICE.

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FOR IMPROVEMENTS OR
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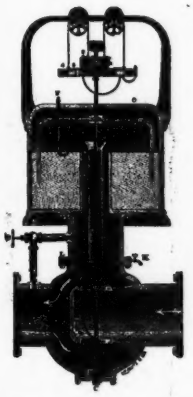

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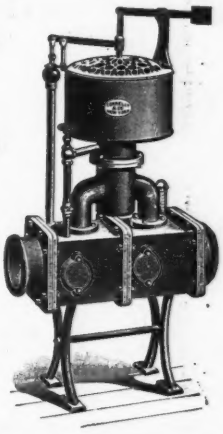
BALANCE GAS GOVERNORS.
"Iron Sponge" and Natural Oxide
FOR GAS PURIFICATION.
EXHAUSTERS, ETC.



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Their Construction and Arrangement,

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FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

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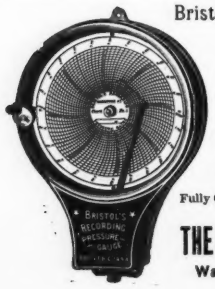

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PRESSURE GAUGE.
For continuous records of
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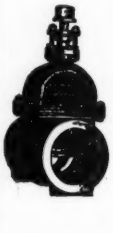

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TROY, N. Y., U. S. A.
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HOT GAS VALVES A SPECIALTY.
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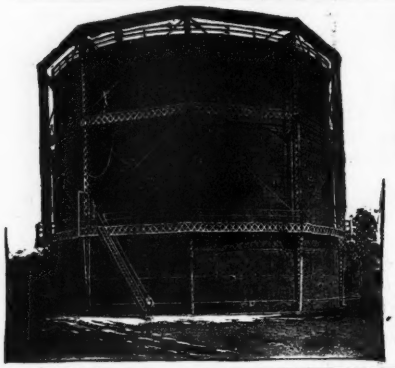

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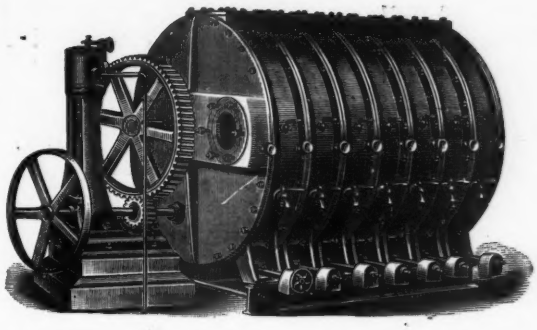

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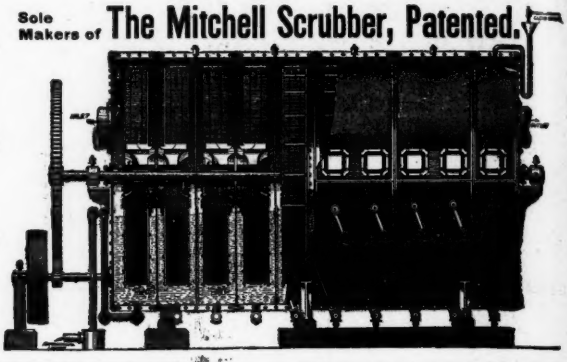

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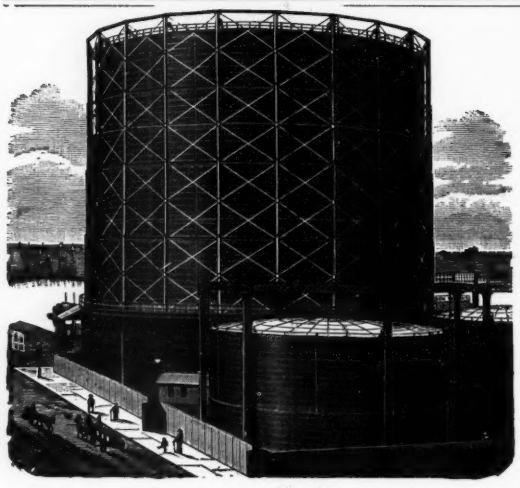

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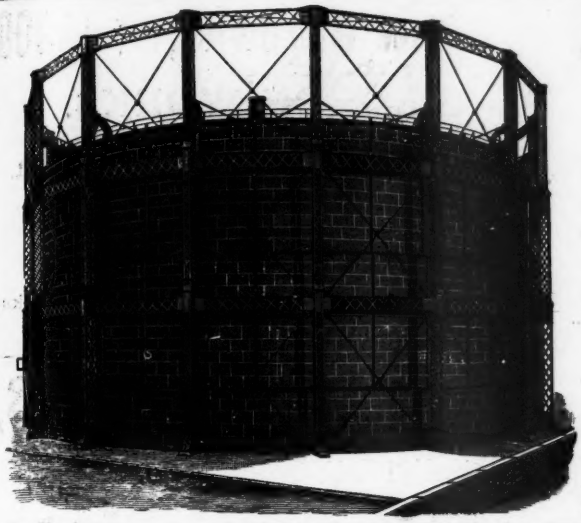

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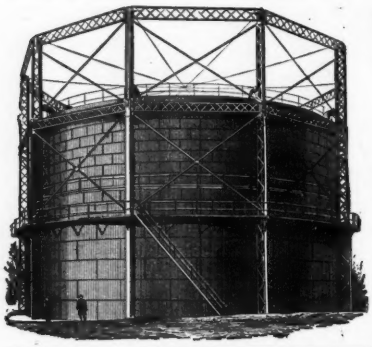

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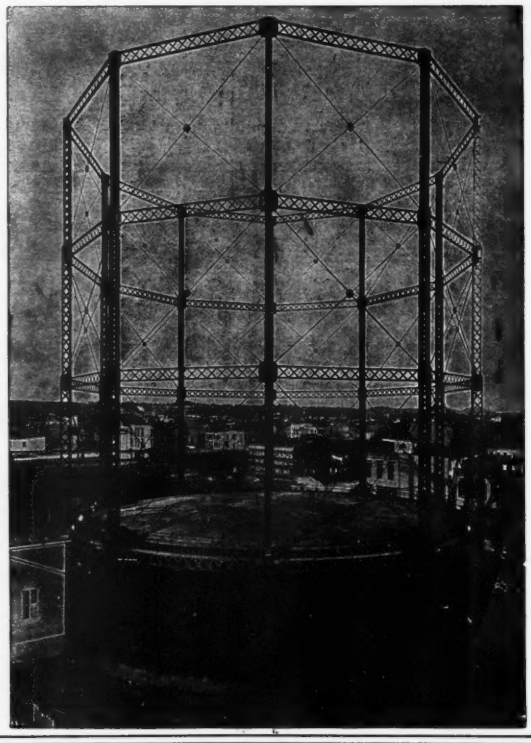

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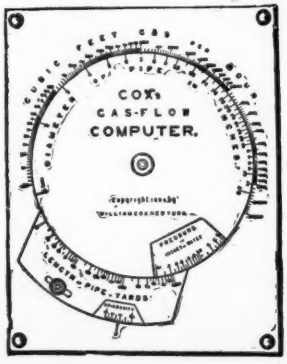

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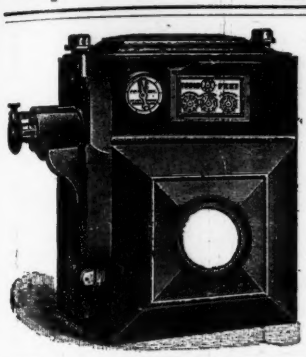

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